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THE VALUE OF CONCENTRATED ARC LIGHT TREATMENT IN CASES OF ROENTGEN AND RADIUM LESIONS OF THE SKIN

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THOUGH, with advancing technic, cutaneous injuries due to over-exposure are fortunately getting less and less frequent, they nevertheless constitute one of the gravest problems which continually confront us in connection with roentgen and radium therapy. Any method susceptible of aiding us in repairing those injuries ought, therefore, to be regarded as important; and it is in this respect that the value of the Finsen treatment, by means of concentrated carbon arc light, has not, as it seems to me, received the attention which it undoubtedly deserves.

I shall speak, in the following, of the technic, and of some results obtained by means of this treatment; but first I shall have to mention, briefly, the various forms of abnormal reaction which the radiation is liable to provoke in the skin. Those reactions may be divided into two groups: *acute* and *chronic*; and to them must be added still a third one, the so-called "*tardy reactions*."

As regards the acute reactions, it is usual to follow the division, established by Holzknecht, into four degrees:

Those of the first degree are characterized by the occurrence, three weeks after the irradiation has taken place, of a slight desquamation, pigmentation and falling out of the hairs. This reaction leaves no lasting traces, and the skin should become normal again in a couple of weeks. It is my experience, however, that the time required

for this return to the normal is often considerably longer, and in some subjects the skin never completely regains its former resistency.

The reaction of the second degree occurs about two weeks after irradiation. It is marked by erythema, swelling and infiltration, often accompanied by some pain and tenderness. It is generally stated that this reaction disappears entirely in the course of a few weeks, all except the pigmentation; but this I believe to be incorrect. If cases of this category are kept under observation for a sufficient length of time—say, for one or two, or three years—it will nearly always be seen that "*tardy reactions*" make their appearance. The skin becomes dry, like parchment, with a tendency to cracking, and it will easily become infected; for instance, the formation of tiny furuncles in the radiated skin is no unusual feature in cases of this kind.

The reaction of the third degree is usually attended by the formation of bullæ. In many cases a rather extensive exfoliation of the outermost cutaneous layers will take place; frequently there will be destruction of the papillæ; the sebaceous and sweat glands will be damaged. It takes weeks, or even months, for this reaction to finish its course, and it always results in atrophy of the skin, with extensive vascular dilatations. The scars will preserve a tendency to ulcerate at the slightest hurt, or under the influence of chemical or thermal influences

so slight that a normal skin would hardly feel them at all. In other words, the patients are, more or less, becoming invalids.

The reaction of the fourth degree is graver, by far. The cases falling within this category are marked by extensive gangrene of the skin and offer but the slightest chance of a cure; for even though they may heal for a time, the tissues will almost invariably end by breaking down again, and new gangrenous ulcerations will form. The reaction is accompanied by intense pain, and in most cases it is necessary to resort to an extensive use of narcotics in order to make life simply bearable to the patient.

The lines separating each of these four types of reaction from the one immediately following or preceding are, of course, entirely vague; the group-division here outlined merely serves to indicate the extreme limit of the characters proper to each of them.

The chronic roentgen alterations occur—besides those in cases in which there has been one single, powerful reaction—especially in cases where the roentgen treatment has been several times repeated; and they can occur as the result of a quick succession of small doses, because, as we all know, the roentgen rays have a cumulative effect. For that reason, they are also frequently met with in physicians, nurses and technicians, whom daily habitude of working with the rays is too apt to render careless in the matter of observing the necessary precautions for protecting themselves.

These chronic alterations take the form of an eczematization of the skin, which often becomes dry, atrophic, with vascular dilations and a tendency to rhagades and fissuration. And besides this, there is, in all these chronic cases, an ever-present risk of carcinoma setting in at one moment or another.

I believe it may safely be said that the general introduction of filters in connection with roentgen radiation has made the occurrence of roentgen burns, both slight and severe ones, a good deal more rare, or at least *relatively* more rare, considering the

enormously more vast extent to which that therapy is now being used.¹ But, on the other hand, the cases of cutaneous atrophy have become more frequent. The reason of this is undoubtedly to be found in the fact that, while the filtration enables us to avoid the severe burns much better than before, our firm belief that this same filtration will, incidentally, secure us against all and any accident to the skin, provided only we take care to watch the dosage properly, has been disappointed, owing to the fact that the cutaneous alterations resulting from treatment by the filtered light in many cases do not set in until a long while—months, and perhaps even years—after the termination of that treatment.

These cutaneous alterations can become so great as to give rise to ulcerations of the skin—the so-called “tardy ulcerations”—without any very marked acute reaction having occurred during the first months, or even years, after the irradiation. Like the roentgen burns that manifest themselves some weeks or months—or, anyhow, a relatively short time—after an irradiation with strongly filtered light, those “tardy ulcerations” take a course essentially similar to that which is observed of roentgen burns following irradiation with non-filtered or only slightly filtered light. But my impression is that they heal more easily, when treated in the right manner.

Besides these roentgen lesions to the skin, we sometimes observe, after treatment with filtered light, the so-called plastic infiltrations of the skin—infiltrations which can break down suddenly and give rise to deep gangrenous processes.

From all this it will be seen that the danger to which the skin is exposed as a result of the roentgen treatment is exceedingly grave indeed; and although the experiences already made—and the ones undoubtedly still to be gathered in the years to come—will probably tend to lessen the number of roentgen accidents of all sorts, it will never become possible to avoid them altogether.

¹ See, however, Strausz: *Schädigungen durch Röntgen- und Radiumstrahlen*; and Hans Meyer: *Lehrbuch der Strahlentherapie*, Vol. I. Urban u. Schwarzenberg, Berlin.

It is, therefore, of the greatest importance that we should be as well and efficiently armed as possible for the treatment of those affections; and it is here that we possess, in the Finsen treatment by means of concentrated carbon arc light, a therapy in many ways of incalculable value, and one which can be used to great advantage in nearly all the forms of roentgen lesions which I have described above.

Treatment by radium can provoke cutaneous alterations precisely similar to the ones which are apt to result from roentgen radiation, and they, too, are wonderfully benefited by the Finsen treatment.

For local treatment of all the affections here mentioned, we always use, at the Finsen Institute, carbon arc light concentrated through the concentrating apparatus devised for that purpose by Finsen himself. Under no circumstances do we use mercury light in this connection, because our experience has taught us that the mercury light—probably owing to its abundant content of short wave rays—has rather a bad effect; so much, in fact, that I have seen instances in which lesions of this kind grew worse as a result of being treated by it.

A detailed description of the armamentarium for Finsen treatment lies beyond the scope of the present paper. I shall only mention that we use specially constructed carbon arc lamps of either 50 or 20 amperes. The light from the lamps is concentrated by means of a system of quartz lenses, which gather the divergent rays emanating from the crater of the carbon arc lamp into a small, very intensely luminous beam which is directed onto the diseased spot. To insure an effect of the light on the deeper layers of the skin it is necessary that the latter should be made bloodless by pressure, at the same time that it must be cooled in order to avoid burns. This double purpose is effected by the use of a compressor constructed by Finsen, consisting of two quartz discs—one plane and the other plano-convex—between which a continuous stream of water is made to flow. These compressors are of different shapes accord-

ing to the contour of the part against which they are to be applied, and it is necessary to have on hand an ample supply of them, with all the differently shaped lenses.

When I began to apply the Finsen treatment to the various forms of roentgen lesions, I was actuated, in the first place, by my desire to try if it would not be possible, in this way, to do something for a class of particularly unfortunate sufferers. At the same time, I found a positive basis for the application of light treatment to these cases in the results of certain microscopical researches undertaken, notably by Dr. Hans Jansen, which showed that treatment of the skin by means of concentrated carbon arc light produces the formation of a very strong connective tissue, rich in new blood vessels. Now, it is a generally accepted fact that, in roentgen lesions of the skin, it is the blood vessels, more particularly, that are injured; and therefore it would be reasonable to suppose that the light treatment, with its stimulating effect on the various organs of the skin, and especially on the blood vessels, would exercise a healing action on the roentgen-diseased tissues.

It was soon discovered, however, that the doses with which we generally work in cases of a non-tuberculous nature—namely, with an irradiation time of from twenty minutes to one hour—were too great, by far; because, as it might indeed be expected, the effect of the carbon arc light was much stronger on the roentgenized skin than on normal cutaneous tissue. It provoked deep necroses, which were difficult to heal and very painful; consequently, we now irradiate for only five minutes at a time, perhaps with slight variations, depending on the seriousness of the cutaneous alteration.

The treatment can be employed for all the various forms of roentgen lesions of the skin; but the results will, of course, be better and all the more quickly obtained the less extensive and severe those lesions are. With very extensive burns of the fourth degree the chances of a good result are, as a matter of fact, exceedingly small.

The treatment takes a long time and demands a great amount of patience, but, on the other hand, the result is usually excellent. The roentgen ulcerations heal; the scars are smooth and elastic; the strength of the skin to resist external influences is very considerable. At the same time, I believe that the danger of roentgen cancer is very greatly lessened.

To look, now, at each of these forms of lesion separately, I will begin by speaking of the roentgen ulcerations of the third and fourth degrees. In treating these we irradiate for five minutes, always beginning by irradiating the margin of the ulcerated area, placing the compressor in such a way that a small portion of the non-ulcerated skin is irradiated at the same time as the diseased part. The compressor must be applied very carefully, so as to fit well and tightly over the area to be treated; partly in order to press the blood away from the tissues, but particularly in order to insure that this area is kept so cool that there will not be the slightest risk of a burn—from the heat of the concentrated rays—which would compromise the result most seriously. For this reason it is necessary, as I have already said, to have at one's disposal a sufficient number of compressors of various forms.

Often the lesions are so painful, especially to pressure, that it becomes necessary to anesthetize them by means of cocaine, which is done by applying for a few minutes, to the spot to be treated, a small tampon of cotton-wool saturated with a 2 to 5 per cent solution of cocaine. This practice is open to the objection that the patient will be unable to feel whether the compressor lies tight against the injured skin, in such a way that the cooling of the latter is effective. In cases of that kind it is, therefore, doubly necessary to be careful about its application, and to see to it that it fits exactly, tightly and firmly to the spot which is going to be treated. The whole lesion is now treated in this manner—by séances of five minutes each; after which some days are let pass, awaiting the result. If no reaction occurs, or only a very slight one, the

irradiation is repeated after a week and can be continued daily until a visible reaction sets in, provided the patient does not become too weak from pain. If this should happen, a stop of some days should be made from time to time, in order to afford him some rest.

The reaction manifests itself by an increased painfulness on pressure, by small necrotic coatings and by hyperemia of the diseased area. This takes from two to three weeks to subside. If the reaction should become very violent, taking the form of increased necrosis, its complete abatement should be awaited before the treatment is resumed, sometimes a period of from two to four weeks.

As the sore gradually becomes cleaner and less painful on pressure, we begin to increase the dose, irradiating for a few minutes longer every day; but in no case have we gone higher than twenty minutes for one sitting. The sores are dressed with some neutral ointment—for instance, zinc oxide, 10 grams; vaseline, 40 grams; adeps lanæ, 50 grams. If the pain is very great, we try hot compresses, and if they do not help, we often use a 2 per cent cocaine ointment—for instance, the zinc-lanolin-vaseline ointment just mentioned, or camomile tea, to which has been added from 0.5 to 2 per cent of cocaine. I have never seen any case either of poisoning or of the patient's contracting the cocaine habit from the use of these dressings, even for a very long time. In the case of such gangrenous ulcerations the resorption is probably very slight anyhow. I am not going to enter, here, into the subject of roentgen lesions and their treatment in general, but I wish to call attention to the surprisingly good effect that is frequently had from these dressings with weak cocaine ointments or solutions. The infiltration, irritation and tenderness which often exist in connection with those lesions subside in a few days, allowing the treatment to be recommenced. Anesthesia has been recommended as preferable to cocaine, but I employ it only seldom nowadays, because, every time I have done so, I have

observed considerable inflammatory reaction in the skin surrounding the lesion.

It not infrequently happens that the ulceration becomes stronger immediately after the irradiation, owing to the breaking down of the roentgen-atrophied skin surrounding the sore, but this need not give cause for anxiety. The treatment can safely be gone on with, all the same, for the phenomenon only shows that this skin is so deteriorated as the result of the roentgen radiation, that it is bound to ulcerate anyhow, sooner or later; and the light treatment will only help to stimulate and nourish it, and gradually to increase its power of resistance.

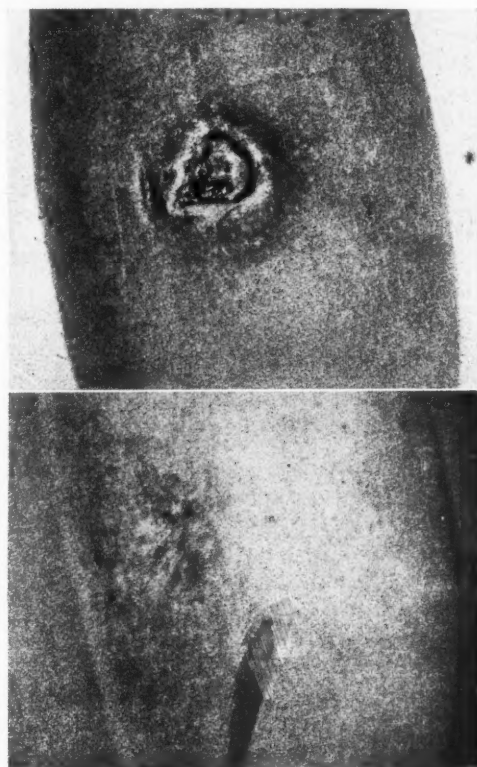
When the sore is finally healed, the treatment should be continued until the skin has become smooth, elastic and vigorous; and no anxiety need be felt even if the repeated light treatment should cause the renewed formation of a necrotic coating on its surface. On the contrary, the appearance of this fresh necrosis is a call to go on with the treatment, because it shows that the new skin is still so lacking in power of resistance that ulceration and necrosis will occur even on the slightest external provocation.

CASE REPORTS

Case 1. Woman, aged 42. Had been roentgen-treated one year before (with non-filtered light) for an onychia; dosage unknown. As a sequel of this treatment a dermatitis set in, with ulceration of the fourth finger, lasting for several months and refusing to heal.

September 18, 1913. On the dorsal side of the fourth finger there is a gangrenous sore, about $2\frac{1}{2}$ cm. in extent, very painful. Patient is unable to work; is very weak, and cannot sleep. Finsen treatment was given from *September 18, 1913, to July 21, 1914*: 280 séances, of 5 minutes each, gradually increasing to 30 minutes each. The lesion has now remained healed for eleven years. Her working capacity is completely restored; she attends personally to all her housework, both washing and cleaning.

Case 2. Woman, aged 37. Had been roentgen-treated, one year before, for a melanosa of the right thigh (large dose, through zinc). Shortly after the roentgen treatment there developed a small



Figs. 1 and 2. Case 2, before treatment (above); after Finsen treatment (below).

sore, which refused to heal. It was excised twice, but continued to break out afresh.

May 27, 1920. On the right thigh there was a deep, gangrenous sore, 2×2.2 cm.

April 23 to July 3, 1920, Finsen treatment: 64 séances of 5 minutes each. Has remained healed for five years. The scar is soft and smooth.

Case 3. Woman, aged 54. Had been treated, one year before, for metrorrhagia, with roentgen ray filtered through 3 mm. Al. Rather soon after, dermatitis resulted, with sores that refused to heal.

August 31, 1920. On the abdomen, over an area as large as the palm of a hand, a

roentgen atrophy, in which there are two painful, gangrenous sores of, respectively, 0.5×1 cm. and 0.5×0.5 cm.

August 31, 1920, to May 12, 1921, Finsen treatment: 114 séances of 20 minutes each. The lesions have remained healed ever since; the scars are smooth and soft.

Case 4. Woman, aged 25. In 1918, she was roentgen-examined (screened) for an affection of her stomach. Two weeks later, an ulceration set in, which subsequently resisted all attempts at healing.

December 1, 1921. On her back there is a roentgen burn as large as the palm of an open hand; partly cicatrized, partly ulcerated.

Finsen treatment, continued for four years, has brought about the healing of the ulcerations except in one spot, about 2 cm. in diameter, just above the processus spinosus, where there remains a small, granulating sore.

Case 5. Woman, aged 29. Had undergone radium treatment abroad, for six years, for lupus vulgaris. Dosage unknown.

April 19, 1922. For some time she had had, beneath her chin, a painful, gangrenous sore, about the size of a pea.

April 19 to June 14, 1922, Finsen treatment: 28 séances.

October 8, 1925. The lesion remains healed. The scar is soft and smooth.

Case 6. A boy, aged 12. Had been treated by means of radium for a keloid, five months before. Two weeks after that treatment ulcerations appeared, which subsequently refused to heal.

August 10, 1922. On the external side of his right thigh there is a gangrenous sore, 2×4 cm. in diameter.

August 12, 1922, to February 6, 1923, Finsen treatment: 120 séances of 15 minutes each. The healing has been permanent since February 26, 1923.

Case 7. Man, aged 36. In 1920, he underwent a roentgen treatment (filtration through 2 mm. Al.) for a cutaneous affection of both feet. Dermatitis resulted, which healed, leaving the skin strongly atrophied. In this atrophied skin, ulcerations began to

appear a few months later. Very severe case of roentgen burn (Fig. 3).

October 20, 1922. Finsen treatment was commenced, with séances of 5 minutes each. The treatment is still being continued, though with long intervals between séances; although considerable improvement has taken place it is doubtful if any complete result will be achieved.

Case 8. Man, aged 58. Had been roentgen-treated twice (with non-filtered light), in the Fall of 1921, for eczema. After a few days he began to have severe pain, and sores commenced to develop. The latter, to all appearances, healed after about three months, but subsequently they continued to ulcerate afresh.

October 23, 1922. On his right hand, between the thumb and the index finger, and extending some distance over the back of the hand, there is a gangrenous sore, the bottom of which is of an irregular, lumpy formation. The area surrounding this lesion is, for a great distance, red and suppurating, and there is considerable tumefaction of the soft tissues (Fig. 4). The patient complains of severe pain, which necessitates the constant administration of narcotics.

During 1922 and 1923 he was given Finsen treatment: 300 séances in all, of 5 minutes each. The sore healed, but the light treatment was continued for a while to reduce the atrophy.

October 14, 1925. The sore remains healed, but the scar is still somewhat hard and rigid (Fig. 5). The mobility in the joint is somewhat restricted, but the man is able to do his office-work.

Case 9. Man, aged 23. In September, 1921, he was roentgen-treated (with non-filtered light) for eczema. One week later, a severe dermatitis broke out, which it took nine months to cure, but in August, 1922, the cicatrix began to ulcerate, and afterwards refused to heal.

January 24, 1923. The back of his right hand showed an atrophically infiltrated cicatrix, 5×8 cm. in diameter, with vascular dilatations. At the base of the third



Fig. 3. Condition of Case 7.

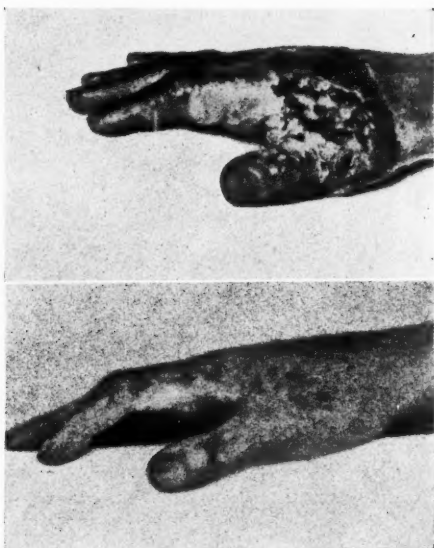
finger there was a deep, necrotic sore, 1×2.5 cm., with raised edges. The surrounding parts are, for a considerable distance, infiltrated and suppurating. The tendon of the third finger adheres to the sore.

January 24 to October 9, 1923, Finsen treatment: 700 séances, beginning with 5 minutes and later increased, up to 10 minutes each. The sore healed, but as the atrophy seemed to be very pronounced, the treatment has been taken up again since March 22, 1924, and is being continued from time to time, with séances of 10 minutes each.

Case 10. Woman, aged 47. Very severe roentgen burn, extending the entire length of the vertebral column, partly with extensive cancer. Treatment given *solaminis causa*. No amelioration could be expected.

Case 11. Man, aged 60. Had been roentgen-treated two years before, for an affection of the right clavicle. Some dermatitis had resulted, which was cured. About a year later—in July, 1922—eczema and sores had appeared in the field of the, to all appearances, healed dermatitis. These morbid manifestations refused to yield to treatment.

September 26, 1923. Over the sternoclavicular joint there is a rather deep, gangrenous sore, 2×4 cm. in extent (Fig. 6). The pain is very great, and narcotics have to be resorted to constantly.



Figs. 4 and 5. Case 8, before treatment (above); after Finsen treatment (below).

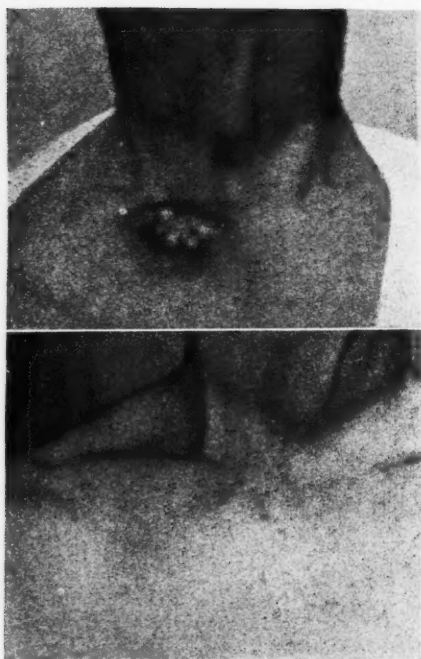
September 26, 1923, to February 25, 1924, Finsen treatment: 150 séances of 5 minutes each, increasing to 10 minutes. The healing of the lesion has remained perfect ever since. The scar is white, smooth, soft and elastic (Fig. 7).

Case 12. Woman, aged 51. Had been treated for metrorrhagia, *five and a half years before*, with roentgen therapy, through 3 mm. Al. One month after, ulcerations had begun, which had since resisted all attempts at healing.

November 16, 1923. Just above the pubic region the skin is atrophic over an area as large as the palm of an open hand, with vascular dilatations and deep plastic infiltration. Within this space are two deep, gangrenous sores, each about 3 cm. in diameter (Fig. 8). Patient suffers intense pain.

November 21, 1923, to March 19, 1924, Finsen treatment: 400 séances of 5 minutes each. Since the termination of the treatment, the lesion has remained healed. The scar is smooth, soft and elastic, with hardly any infiltration (Fig. 9).

Case 13. Woman, aged 25. Had been treated with radium, *10 or 11 years before*,

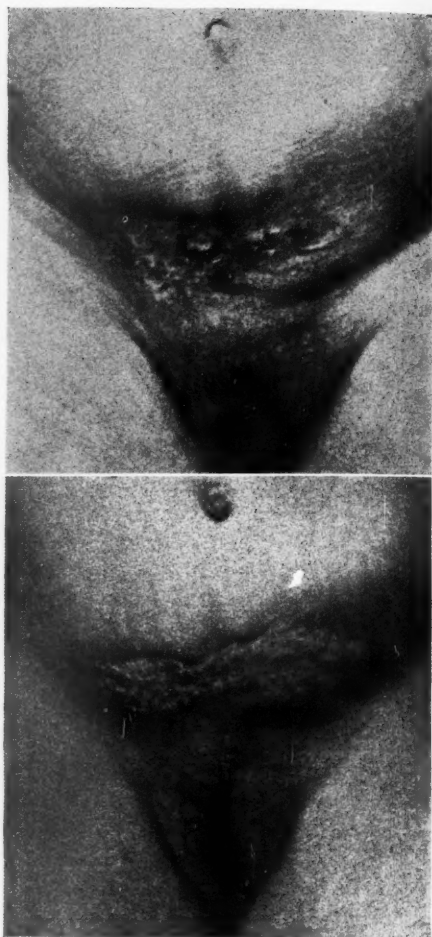


Figs. 6 and 7. Case 9, before treatment (above); after Finsen treatment (below).

for a flat, red birthmark. The radiation had produced a strong reaction.

December 17, 1923. The whole of the left cheek, eyelid and surrounding parts are taken up by a large cicatrix, with vascular dilatations here and there, with spot-wise pigmentation, and with small gangrenous sores in different places. The eyelids are so swollen that they can open only as a narrow slit; there is a rather severe conjunctivitis.

Since *December 17, 1923*, this patient has received Finsen treatment: 2,000 séances in all, of 5 minutes each, later increased to 10 minutes each. Her condition has been enormously improved. The atrophic, infiltrated skin has become smooth and elastic; the swelling of the eyelids has subsided, so that the eye can be opened spontaneously to almost its full extent and the patient now has the full use of it. The light treatment is still being continued, however, for cosmetic reasons, as we be-



Figs. 8 and 9. Case 12, before treatment (above); after Finsen treatment (below).

lieve it possible to improve her looks a good deal more.

Case 14. Woman, aged 22. Had been roentgen-treated for eczema in *December, 1923*. A resulting, rather severe dermatitis was healed in the course of a couple of months, but in *August, 1924*, the patient had a whitlow, and as a sequel of this, the roentgen lesions broke out afresh and refused to be healed.

February 4, 1925. On the back of the right hand there is an infiltrated cicatrix, 9×13 cm., with numerous vascular dilatations; and, in this, two sores, superficially

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necrotic, of dimensions, respectively, 1×1.7 cm. and 0.5×1.8 cm. The back of the left hand forms one large atrophic cicatrix, with vascular dilatations. The patient suffers intense pain and cannot sleep unless under the influence of narcotics.

February 4 to May 25, 1925, Finsen treatment: 570 séances, in the beginning of 5 minutes each, later increased up to 10 minutes each.

September 24, 1925. Condition good. The scar remains healed, and is soft and elastic. She is working as sick-nurse.

Case 15. Woman, aged 53. *Seventeen years ago* she was roentgen-treated for a tumor in her neck. The dose is unknown, but the treatment extended over a considerable period. There resulted eczematous alterations, vascular dilatations and atrophy of the skin. Two years ago ulcerations began to appear, which not only resisted all treatment, but became gradually more and more extensive.

March 20, 1925. The region above and around the left clavicle, for an area of 12×15 cm., shows a typical roentgen atrophy. Its central portion, for about 7×10.5 cm., presents numerous gangrenous ulcerations, and there is also some plastic infiltration (Fig. 10). The sore is intensely painful; the patient is in a very nervous state, and has to resort to narcotics continually.

March 20 to June 9, 1925, Finsen treatment: 270 séances of 5 minutes each. The sore has now remained healed for five months. The scar is smooth, soft and elastic. The patient, who is manageress of a laundry, has regained her full working capacity.

Case 16. Woman, aged 73. Had undergone a roentgen treatment, *in 1911*, for pains in her chest and back, soon after which cutaneous alterations (roentgen atrophy) set in. A year and a half before she presented herself for treatment, there appeared ulcerations, which refused to heal.

May 9, 1925. On her back, between the shoulder-blades, the skin is roentgen-atrophied over a surface measuring 22×11



Fig. 10. Case 15, before treatment.

cm. A portion of this area, 6×5 cm., is crusted, with small sores.

May 9 to August 21, 1925, Finsen treatment: 240 séances of 5 minutes each.

September 8, 1925. The lesions are healed; but it is deemed advisable to go on with the treatment, with a view to reducing the atrophy.

Case 17. Man, aged 54. Since 1914, this patient had during some years been roentgen-treated several times for eczema of the anus. As a sequel of these treatments there developed an atrophy, in which, during the past year, small sores have formed, which refused to heal.

May 20, 1925. Beginning a little way inside the anal orifice, and extending for some centimeters outward, onto both nates, there is a typical roentgen atrophy with several necrotic sores, each as large as a pea. There is some pain.

Since June 16, 1925, Finsen treatment has been given: séances of 5 minutes each, gradually increased to 10 minutes each; for eight days in succession, with intervals of from two to three weeks. The condition is noticeably improved. The treatment is being continued.

We have treated, in all, at the Finsen Institute, twenty-one cases of roentgen lesions: partly cases which have occurred as immediate sequelæ of the roentgen irradiation, partly cases occurring as "tardy ulcerations." Of these twenty-one, four patients broke off the treatment prematurely. Of those, I wish to remark that two of them were cases of ulceration in the anal region subsequent to treatment for cancer of the rectum. Both died rather shortly afterwards from their cancers. The other two were cases of very severe roentgen burn, and neither of them had the patience required to keep on with the treatment to the finish.

Of the remaining seventeen, thirteen were cured. In one case the treatment had no effect, but it should be remarked that in this case (Case 10) there was already a roentgen cancer present at the time the Finsen treatment was instituted. Three cases are still under treatment, and have improved; in one of them (Case 4) the healing is complete except for an ulceration about 2 cm. in diameter, which still remains. In this last-named case, the treatment had extended over several years; and as the skin surrounding the ulcerated spot had become healthy and well-nourished, it occurred to me that it might perhaps be possible, in order to shorten the treatment, to extirpate the small ulcer, which lay directly over the processus spinosus, and was apparently gangrenous all the way down to the bone. That operation was, consequently, performed by Dr. Chiewitz, the chief surgeon of the Finsen Institute; but whether it has been successful or not it is yet too early to say. Plastic operations like the one performed in this case are recommended, for roentgen gangrene of the skin, by various text-book authors; but I wish to point out that, to be successful, it is required that not only the entire ulcerated portion should be completely extirpated, but that also the roentgen-atrophied skin surrounding the gangrenous area should be removed, and the defect covered with a pedunculated flap. There has been no possibility of do-

ing this in any of the cases which have come under my hands for Finsen treatment; and altogether it is only rarely that the conditions for an operative treatment of the kind here indicated will be present, simply because the cutaneous roentgen alterations will be too extensive. And to all this there interposes still another difficulty; namely, that it is by no means certain whether the attempt to make the flap grow to the wound-surface will be successful. A failure in that respect is, at least, what I have myself had occasion to observe in two cases of this kind. The value of this operative treatment is, therefore, hardly as great as it might appear at a first glance.

From the reports it will be seen that in two of the cases (11 and 15) there were plastic infiltrations, which disappeared as a result of the Finsen treatment.

Taken as a whole, the case reports show that in the treatment by means of concentrated carbon arc light we possess a therapy most splendidly effective as regards the treatment of roentgen lesions. In all the cases those lesions were of such a character that there was not the slightest chance of their healing being accomplished by any other means, inasmuch as they had already existed for some time. Furthermore, it should be remarked that the scars resulting from the cicatrization are elastic and well-nourished, and therefore in every way capable of resisting outward influences. For a considerable number of the patients—for instance, Cases 1, 8, 9, 12, 14 and 15—the result of the treatment has meant a change from partial invalidism to perfect working capacity.

That the results will remain permanent is something about which I do not entertain the slightest doubt; partly because, in some of the cases, the restitution already dates back a number of years, and partly because, in the more recently healed cases, the whole appearance of the skin has become entirely changed, and has completely lost its roentgen-atrophied character.

As has been seen from the record of the cases, the treatment takes a very long time

and demands a great deal of patience, but for patients so severely affected that consideration will probably, in most cases, be of minor importance, after all.

It is evident that, besides the treatment with the concentrated light, every other means at disposal should be called into service, which may in any way be thought susceptible of shortening the time demanded by the treatment; but that it should be possible to heal severe, extensive roentgen burns of the fourth degree must not be expected.

It now only remains for me to speak of the chronic roentgen changes, among which I include the atrophy and vascular dilatations that appear at a late period as a sequel to treatment by means of filtered light. At the Finsen Institute we have treated upwards of 150 cases of this kind. In a part of those cases the changes consisted in slighter atrophies, with vascular dilatations; but besides these we have had a number of cases in which there was a stronger redness, infiltration, eczematization of the skin, together with a tendency to rhagades and fissuration. In all these cases the effect of the Finsen treatment seems to have been extremely good. The skin became soft, elastic and vigorous, and the tendency to crack disappeared. At the same time, the vascular dilatations disappeared. In cases where the lesions involved the hands of the patient, thereby incapacitating him, more or less, for his usual occupations, the full working capacity was restored.

It cannot be expected, of course, in cases of this kind, that it should be possible to restore to the skin its one-time, normal appearance, for the morbid changes worked by the roentgen rays will nearly always have been too profound. And yet, in a good many instances, the treatment has helped the patients in this respect, and the results appear to be lasting. Our period of observation extends over several years.

I have said that the vascular dilatations disappear; and in a number of cases in which extensive telangiectases were particularly disfiguring to the appearance of the

patient we have, by means of a very discreet light treatment, obtained some good cosmetic results—reducing the vivid coloring of the lesion so much that, thenceforth, it was possible to hide the disfigurement more or less effectively by the application of a little powder. In cases where there are only less pronounced reddish patches, my advice is against that sort of treatment—unless there are fissures or a tendency to the periodic formation of small sores—because, as I have already said, it is impossible to restore the normal appearance of the skin. The latter will always, after treatment, be whiter than its surroundings, and there may also be some pigmentation, which will contrast more or less markedly with the healthy skin. It is possible that eventually a technic will be found which will enable us to treat such cases successfully. I have found quite recently, in a few cases, with irradiation for so brief a time—from 3 to 5 minutes—that only the very feeblest reaction was produced, and I have found, when proceeding in this manner, that the vascular dilatations will disappear after a few treatments, leaving a soft and elastic skin of a color which contrasts only slightly with that of its surroundings.

In all other respects, the technic employed in the treatment of the chronic roentgen changes is precisely the same as the one employed for the true roentgen burns, and it requires the same meticulous care and exactitude in its application. We irradiate for five minutes at a time to begin with, and work over the entire surface of the lesion once, beginning at the margin. We then wait and observe the degree of the ensuing reaction, after which the radiation is repeated. If the reaction is only slight, the intervals between the successive treatments may be rather brief, and the dose may be increased little by little, but never to exceed about twenty minutes for each séance.

In cases where the chronic changes produced in the roentgenized skin are more or less severe, the reaction to the Finsen radiation will often be seen to take the form of

sores resembling roentgen burns. This need not cause any anxiety, however. These sores will heal in good order, and the scar tissue will be soft and elastic; only, the treatment should be suspended until the reaction has subsided completely, which will often take from three to four weeks. If, after that length of time, there should still be some small sores left, the treatment may nevertheless be resumed, because the continued presence of these sores simply shows that we have to do, in that case, with conditions which were bound to result in ulcerations sooner or later. Against such conditions the light treatment is in itself the best remedy. But in such cases the dose of radiation should not be lengthened until the skin has become more vigorous and more capable of resistance.

The treatment must be kept up for a considerable length of time—often for months—before a really satisfactory result is achieved. The sores are dressed with some neutral ointment.

X-ray examination in pregnancy. — The author refers to a case recorded by Essen-Møller in 1920 in which a skiagram, taken immediately before delivery, showed three fetal heads. He reports a somewhat similar case. A primipara, aged 29, was admitted to hospital when seven months pregnant. There was present generalized edema, especially of the lower extremities, and albuminuria. Two fetal heads could be felt and fetal heart sounds were heard in each flank, with a "silent area" in the midline. The diagnosis of "twin pregnancy" was made. Skiagrams of the abdomen and pelvis showed two fetal heads and the shadow of a vertebral column between

SUMMARY

The author has treated a number of roentgen ulcerations, roentgen atrophies and other morbid cutaneous changes resulting from the exposure to roentgen rays, by means of concentrated carbon arc light (Finsen treatment), and he calls attention to the great value of that therapy in connection with the roentgen lesions thus enumerated.

He describes the technic of the treatment and points out that it is the concentrated carbon arc light that must be used, and not the mercury light, from which he has, in some cases, seen, on the contrary, a decidedly harmful effect.

He considers the results obtained as lasting; partly because, in a number of the cases treated, the healing is still perfect after several years, and partly because the skin has lost its roentgen-atrophic character and has become smooth, soft, elastic and well-nourished.

those of the heads, which obviously belonged to neither. One week after admission, labor commenced, and three female children were born alive, but in spite of injections of pituitrin and ergot, the uterus failed to contract. The patient lost about 1,200 c.c. of blood, and died ten hours after the termination of labor. The author emphasizes the value of skiagrams in all doubtful cases of multiple pregnancy.

The Value of Radiography in Pregnancy.
S. Genell. *Gynécol. et Obstét.*, Jan., 1926, p. 41.
(Reprinted by permission from *Brit. Med. Jour.*, March 6, 1926, p. 44 of *Epitome of Current Medical Literature.*)

INTERPRETATION OF THE PYELOGRAPHIC SHADOW¹

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WHEN I was asked to select a subject for a paper to be included in this symposium it occurred to me that a discussion of the interpretation of the pyelographic shadow might be of interest, since a survey of a large number of nephrectomies and nephrotomies had indicated that the correct interpretation of the deviations from the normal outline as presented by a pyelogram of a kidney pelvis and its calyces is by far the most important factor in the pre-operative diagnosis of pathological conditions of the kidney.

In view of the fact that the pyelographic finding often decides the advisability of a surgical operation, it would seem appropriate to offer a review of some of the characteristic lesions of the kidney which may be determined by pyelographic examination, together with the possibilities of error in the interpretation of the pyelograms. Such errors are perhaps most frequently due either to a failure to recognize a congenital anomaly of the kidney pelvis or to an attempt to interpret an incompletely filled kidney pelvis. The technic of filling the pelvis should be well mastered and the types of anomalies which may be encountered should be thoroughly understood.

A review of the *anomalies* of the kidney is of prime importance, since the possibility that any deviation from the normal kidney pelvis may be due to some anomaly must always be considered. These anomalies range from the embryonic type of kidney pelvis to the pelvis with many calyces; from a pelvis with an elongated cephalic calyx to one in which the pelvis and ureter are completely divided as far as the bladder, and from a slightly rotated pelvis to the almost completely inverted pelvis of the horseshoe kidney. There are also many bizarre pelvises presenting an infinite variety of shapes, among which may be noted especially the pelvis of the misplaced kidney or

ectopic kidney, the latter of which must always be distinguished from the pelvis of the movable kidney.

The normal embryonic pelvis is usually small and has three major calyces, short and small, but all regular in outline, with the normal cuffed endings produced by the minor calyces. That is, in a pyelogram of the usual embryonic pelvis, the shadow is like a miniature of that of a normal pelvis. The pyelogram of congenital atrophy of the kidney is usually identical with the above picture. This type of anomaly is most frequently confused with a pyelitis in which the infection has produced a contraction of the kidney pelvis. In advanced cases, however, pyelitis produces a clubbing of the ends of the calyces, while in early cases it produces a narrowing of the infundibulum, with distortion of the minor calyces, giving to the pyelogram a rather characteristic appearance which usually may be distinguished from the shadow of the embryonic type of pelvis.

The pyelogram of the anomalous pelvis with from four to seven or more calyces shows clearly the multiplicity of calyces, each with a more or less regular outline and definite termination although they vary considerably in size. A correct interpretation of a pyelogram of this type is not difficult.

In the case of a pelvis with a long upper cephalic calyx it may be difficult to determine just when it should be considered pathologic, but we have come to believe that in most cases these elongated calyces are anomalous and have no clinical significance. The characteristic feature of this type of pelvis is its dumbbell-shaped calyx, a characteristic which should always be borne in mind when attempting to determine the presence of a pathologic condition in the cephalic or upper kidney pole. The appearance of such a calyx on an otherwise normal pyelogram should suggest the possible presence of one of the following conditions:

¹ Read before the Radiological Society of North America, at Cleveland, Dec., 1925.

First, the possibility of a duplex kidney, with fusion of the two ureters somewhere along the course of the ureter or with complete separation of the ureters to the bladder. The latter condition will usually be discovered by the cystoscopic survey of the bladder, which will show the two openings into its lumen. If the ureters are fused higher up, with only a single outlet into the bladder, they may be difficult to determine. The ureterograms have become of the utmost value in this connection, as they will usually show the point of bifurcation.

Second, the single dumbbell-shaped cephalic calyx may indicate the obliteration of the balance of the kidney pelvis by pathologic changes in the kidney, most often by a tumor.

Third, when only a cephalic calyx is visible this condition may be due to a stricture of the infundibulum, but in such a case the calyx will be more or less dilated as the result of a localized hydronephrosis, and the tip of the ureteral catheter will of necessity be the obstructing factor in the narrow infundibulum. In this type of case the caudal calyx may be demonstrated by withdrawing the catheter to the lower pelvis and making another injection.

The duplex pelvis in the misplaced kidney may present an entirely different problem from those described above and many bizarre forms may be seen.

The rotated kidney is perhaps most often seen in cases in which the kidney has never attained its normal position and it is then truly a congenital condition, although it may not be classed as a truly misplaced kidney. This condition may be recognized by the direction assumed by the calyces and also by the point at which the ureter enters the kidney pelvis, always anterior or posterior to the normal position of the ureteropelvic junction.

The fused kidney, which is usually of the "horseshoe type" but which may occasionally be a "sigmoid kidney," in which one pelvis lies above the other, the formation simulating the letter "S," may usually be determined by observing the relative posi-

tions of the ureter and the calyces. In the horseshoe kidney the ureter enters well out from the midline and the pelvis lies at the upper portion of the pyelogram, with the calyces dropping downward and inward. This picture is so characteristic that it may often be interpreted immediately as indicating a horseshoe kidney, while the sigmoid kidney will show one pelvis above the other, the position of each being reversed.

A misplaced kidney is first suspected from its abnormal position on the pyelogram; thus, it may be in the pelvis, the "pelvic kidney," or higher, at the level of the promontory of the sacrum, or it may lie at the level of bifurcation of the aorta—perhaps the most frequent location. These misplaced kidneys also usually have an anomalous pelvis, which is either a true anomalous formation or the result of faulty rotation.

The misplaced kidney must be differentiated from the floating or movable kidney. The latter condition may be suspected when the pyelogram shows an apparently normally formed pelvis with a tortuous or kinked ureter. In such a case, plates taken with the patient in the horizontal position and in the upright position will usually demonstrate the movability of the kidney.

The presence of *hydronephrosis* may be determined from the pyelogram with a great degree of accuracy if it is possible to inject the pelvis of the kidney. This pathologic condition is evidenced by dilatation of the kidney pelvis and calyces, with accompanying destruction, which may leave only a mere shell of the former kidney. All degrees of dilatation may be encountered and the greatest difficulty in interpretation comes in the early cases in which it is difficult to differentiate the slightly dilated pelvis from a large normal pelvis. The degree of hydronephrosis is no criterion of the amount of obstruction present, as a severe complete obstruction may produce suppression of urine by the back pressure in the kidney and but little resultant dilatation, while a long continued intermittent obstruc-

tion may carry on to enormous pelvic dilatation.

The most frequent intrinsic causes of hydronephrosis are kidney stones in the pelvis, ureteral calculi, stricture of the ureter, an enlarged prostate, stricture of the urethra of male children, and, rarely, congenital stricture of the lower end of the ureter. Among extrinsic causes may be included tumor, an abnormal renal artery, pregnancy, and the ptosed kidney. The usual early evidences of hydronephrosis as seen on the pyelogram are obliteration of the minor calyces and loss of the cuffed ends which characterize the normal calyx, together with distention of the pelvis and consequent dilatation of the calyces. Hydronephrosis may be identified by the presence of a calculus in a calyx; or, if it is due to a stricture of the infundibulum, it will be demonstrated by the presence of a dilated calyx, the remainder of the kidney pelvis being normal.

Empyema of the kidney is part of a systemic process and involves both kidneys. It is characterized by small pin-point abscesses arranged in little groups. The pelvis of the kidney is seldom involved, so that little or no evidence of this type of infection can be determined by a pyelogram.

Pyelonephritis, also, is a disease which shows but little pelvic involvement. There is sometimes evidence of inflammation in the pelvis, but no particular distortion or destruction. The infected areas are wedge-shaped, with the apex at the border of the pelvis and the base toward the cortex. These may rupture through the cortex and give rise to a perinephritic abscess. These abscesses sometimes drain into the pelvis of the kidney or into the ureter and, therefore, if the pyelogram reveals the passage of the medium into the fistulous tract, it may be considered a clue to the presence of a perinephritic abscess. Little or no evidence of the disease can, however, be determined from the appearance of the pelvis of the kidney.

A true *pyelitis* is probably seldom or never present, as the infection is not confined to the pelvis. This portion of the kidney is, however, so predominantly involved in an infection that the diagnosis of pyelitis serves well from a clinical standpoint. The acute cases are markedly inflamed, with dilatation of the calyces and pelvis, the so-called clubbing of terminal calyces, ulceration, destruction, round cell infiltration followed by connective tissue formation, contraction of pelvis and atrophy of the parenchyma. In the earlier stages the pyelogram may show pelvic dilatation and dilated calyces with clubbed ends, a picture which is more or less characteristic of pyelitis, and, in the later stages, contraction of calyces or pelvis as the disease progresses.

Pyonephrosis is a frank infection of the kidney, with abscess formation, dilatation of the pelvis and calyces, which are filled with pus, abscess formation and cavitation of the renal parenchyma and connective tissue repair. These conditions are manifested in the pyelogram by dilated pelvis and calyces, by areas of contraction and the center of an old abscess in the kidney, and by enlargement of the kidney as a whole. Little trouble is experienced in the interpretation of a pyelogram of this type.

One specific type of infection which should receive special consideration is *tuberculosis of the kidney*.

Miliary tuberculosis gives a typical empyema, such as has been described above, and has no significance from a roentgenologic standpoint. *Chronic or ulcerative tuberculosis*, on the other hand, is of interest. *Colon bacillus infection* behaves much as tuberculosis except that the latter produces much more destruction. The primary renal lesion is usually in the pole and ulcerates into the calyces or pelvis, so that the whole kidney becomes infected, the lymphatics carrying the infection to the capsule. The pyelogram of a tuberculous kidney often shows large areas of destruction, with fringed edges which assume an ostrich-plume appearance and are quite characteristic. Many cases, however, can-

not be differentiated from other types of pyonephrosis.

Before considering renal tumors it seems well to mention a condition which sometimes influences the interpretation of the pyelographic shadow, that is, the lesser density shadow in the pyelogram caused by phosphatic stones which are unrecognized by the ordinary kidney examination. These areas are usually irregular in outline and conform in shape to the portion of the pelvis or calyces which is filled with the concretion. Occasionally a rounded smooth stone may simulate a papilloma of the kidney pelvis, the presence of which should be suspected in the presence of considerable hemorrhage, and especially if similar tumors are found in the bladder.

The contribution of the pyelogram to the differentiation of *tumors of the kidney* is of especial importance. Ewing has shown that many of the so-called *hypernephromata* of the kidney are *adenocarcinomata*. These tumors, which usually occur in the pole of the kidney, rapidly encroach on the calyces and produce obliteration or compression and displacement. The characteristics, therefore, which should be considered in the interpretation of the pyelogram in a case in which a tumor is suspected are enlargement of one pole of the kidney, with obliteration, compression or distortion of the calyces in that area. The tumor may invade the entire kidney and the pelvis may be more or less obliterated, the calyces becoming elongated and spindle-shaped, with dilated ends.

Embryoma, the sarcoma of children, may start in the pelvis or in either pole of the kidney. As this tumor occurs in children the pyelogram need scarcely be considered as a diagnostic aid.

Papilloma of the renal pelvis may be associated with renal calculi, and produce a deformity of the pelvis consistent with its development in the pelvis. Frequently implants in the ureter may cause obstruction and consequent hydronephrosis. No very characteristic pyelographic shadow is found in most cases of papilloma of the kidney.

But little is known regarding the etiology of *polycystic kidneys*. In this disease the kidneys—for the disease is usually bilateral—become converted into cystic areas. Their function is poor and a pyelographic study is not considered a wise procedure. When a pyelogram is taken, however, the cystic areas protruding into the calyces and pelvis give a rather characteristic picture. The diagnosis in these cases should, however, be made from the plain X-ray film, which will show areas of lesser density and nodular cyst-like areas in the cortex.

A *solitary cyst* may be so small and project so slightly from the pole of the kidney that it is unrecognized. These cysts, however, may become large and show a characteristic tumor-like projection from the kidney, the pressure of which causes some distortion of the neighboring calyces.

SUMMARY

1. We believe the diagnosis of a pathological condition in the kidney is most often established by means of a pyelogram.

2. The advisability of surgical interference and the type of operation to be performed are usually decided in accordance with the pyelographic findings.

3. The radiologist should have a thorough knowledge of all anomalies which may be present in the kidney in order to make a clear diagnosis of any pathologic condition.

4. Errors in the interpretation of pyelograms are due to failure to recognize anomalies, and to incomplete filling of the kidney pelvis.

5. The important anomalies may range as follows: (1) From the small embryonic type of kidney pelvis to the large pelvis with numerous calyces; (2) from the elongated cephalic calyx to the bifurcation of the pelvis and ureter as far as the bladder; (3) from the slightly rotated pelvis to the almost inverted pelvis in the horseshoe kidney; (4) the innumerable bizarre formations of congenitally abnormal pelves and of the pelves of misplaced kidneys.

6. The embryonic pelvis may be found in a congenital atrophy of the kidney. This type of pelvis may be confused with the contracted pelvis of pyelitis.

7. The dumbbell shape of the cephalic calyx is an important lead in the interpretation of a bifurcation of the ureter when only the upper calyx is filled; this condition should be differentiated from a tumor of the lower pole.

8. A ureterogram should be made if bifurcation of the ureter is suspected.

9. The misplaced kidney should be differentiated from the floating kidney by films made in both the upright and the horizontal positions.

10. The rotated kidney may easily be recognized; the inverted type of pelvis with the calyx drooping downward is characteristic of the horseshoe kidney.

11. Hydronephrosis in an early stage is to be suspected when the minor calyces are obliterated and the calyces and pelvis are dilated.

12. Hydronephrosis is caused by renal calculi, ureteral calculi, ureteral stricture, tumor of the ureter, enlarged prostate, a congenital valve in the posterior urethra of a male child, an abnormal renal artery, a movable kidney with kink or torsion of the ureter, pregnancy, a tumor with compression on the ureter, or a tabetic bladder.

13. Localized hydronephrosis is caused by tumor, calculi in a calyx, or a stricture of the infundibulum.

14. The degree of hydronephrosis is no criterion of the severity of the obstruction.

15. The pyelogram does not disclose an empyemic kidney.

16. Pyelonephrosis is not evident on the pyelogram unless a perinephritic abscess has formed and has ruptured into the pelvis or ureter.

17. Clubbing of the calyces and moderate dilatation are early evidences of chronic *pyelitis*. Later, contraction may take place, producing a small distorted pelvis.

18. Pyonephrosis is evidenced by a dilated pelvis and calyces, by areas of necrosis shown by abscess cavities, by areas of connective tissue repair in the kidney, and by enlargement of the kidney.

19. Tuberculosis of the kidney is a pyonephrosis and may show a characteristic irregular pyelographic outline with an ostrich-plume appearance.

20. Phosphatic stones in the kidney pelvis usually assume the shape and size of the pelvis; if they are spherical they may simulate tumor.

21. Adenocarcinoma and hypernephroma usually originate in the pole of the kidney and encroach on calyces, or they may involve the pelvis and produce long spindle-shaped calyces with clubbed ends.

22. Embryoma, the so-called sarcoma of children, is seldom pyelographed.

23. Papilloma deforms the pelvis and may be accompanied by stone and hydronephrosis due to transplants in the ureter.

24. Polycystic kidney is usually not pyelographed, but when this is done, characteristic cystic areas encroaching on the pelvis are seen.

25. A solitary cyst, if large, encroaches on the terminal calyces.

VARIATIONS IN NORMAL PYELOGRAMS¹

A CLINICAL RADIOLOGIC STUDY

By DANIEL N. EISENDRATH, M.D., and ROBERT A. ARENS, M.D., Urologist and Roentgenologist, respectively, Michael Reese Hospital, CHICAGO, ILLINOIS

WITH the adoption of ureteropyelography as an almost indispensable portion of a complete urologic study, the question often arises as to what constitutes a normal basis for comparison of pyelograms. This is especially true of two conditions of the kidney, *viz.*, inflammatory changes and neoplasms. Our interest in the subject was aroused by encountering several recent cases in which the principal clinical symptom was hematuria and the apparent pyelographic deformity such as to greatly resemble that of a neoplasm. The latter was not found at operation, but a comparison of the renal pelvis as seen in the specimen with that of the pyelogram convinced us that there were a number of normal renal pelvises which, when filled with opaque media, could greatly resemble the so-called "spider deformity" due to a renal neoplasm. We have, therefore, thought that a service would be rendered other roentgenologists and urologists by a survey of our material as to the many variations of the normal renal pelvis as seen in pyelograms, in order that mistakes, especially in the diagnosis of renal neoplasms, might be minimized in the future.

For a number of years the division of the types of normal pelvises into ampullary, bifid and trifid has been generally accepted. There can be no objection to continuing to employ the terms "ampullary" and "bifid," but it is advisable to discard the "trifid" because of the rarity of the condition.

It is our practice to make ureteropyelograms of both sides at the same sitting unless there are contra-indications. The technique which we have developed is as follows:

1. With the opaque ureteral catheters on both sides *in situ*, we make separate plain exposures of the upper and lower

urinary tracts to ascertain whether calculi are present.

2. Both pelvis are injected simultaneously with the opaque medium (12.5 per cent sodium iodide) until the resistance is felt, indicative of complete filling of the renal pelvis. Another exposure is now made.

3. After both ureteral catheters have been completely withdrawn, an additional exposure is made. This should show the entire length of both ureters, as well as the renal pelvis, filled with the opaque medium. We have never seen any undesirable complications from the above described technic.

The pyelograms utilized for the present study were chiefly those of the side opposite to that to which the clinical symptoms and findings pointed. In the remainder, they were obtained in cases where all findings were negative.

We believe that the material can be most conveniently divided into groups. Some of these are simply variations of the ampullary pelvis. Others show the transition of one form of the latter, *viz.*, the one with a long cephalic (superior) major calyx into the bifid pelvis and this again into the kidney, with division into two separate pelvises. A third large group we propose to call the "pseudospider" type of normal pelvis, and a final group we are unable to classify. Taking these up separately we will first discuss the classical ampullary type of renal pelvis as seen in Figure 1.

Here the ampulla-like, almost quadrilateral expansion of the renal pelvis proper is most marked, there being a gradual narrowing toward the ureteropelvic junction. There are three major calyces, superior, middle and inferior. The origin of the middle is inconstant, *i.e.*, it may arise from the renal pelvis proper or from the superior

¹ Read before the Annual Meeting of the Radiological Society of North America, at Cleveland, December 8, 1925.

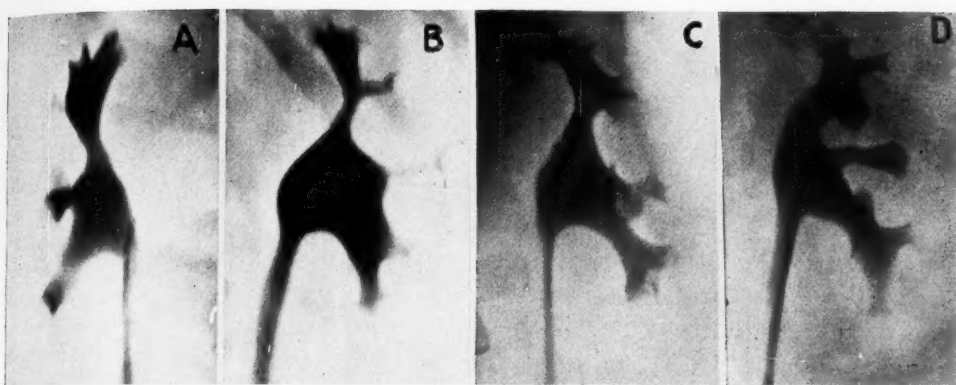


Fig. 1. Classical ampullary pelvises. *A*, *C*, and *D* show well developed superior, middle, and inferior major calyces with relatively wide necks. In *B*, note narrow-necked superior and middle as compared to wide-necked inferior major calyx.

or inferior major calyx. As a rule the necks of both the major and minor calyces are quite narrow, but it is well to remember that there is much variation in this direction, as seen by comparison of the pyelograms shown in *B* and *D* of Figure 1.

In Figure 2 we observe slight deviations from the examples of the ampullary type shown in Figure 1. The special feature is the relatively marked development of both the major and minor calyces, so that the pelvis proper constitutes a small portion of the pyelogram.

This tendency towards predominance of (a) the pelvis over the calyces or (b) the opposite condition, *viz.*, the calyces over the pelvis proper, is well seen by comparing the pyelograms as shown in Figure 3 with those seen in Figure 4. Taken as a whole, the pelvises in Figure 3 still belong to the ampullary type, but in those of Figure 4 one can note, especially in *B*, a tendency toward the "pseudospider" of Figure 8. In this case (*B* of Figure 4) there was persistent severe bleeding from this left kidney and a diagnosis of probable left renal neoplasm was

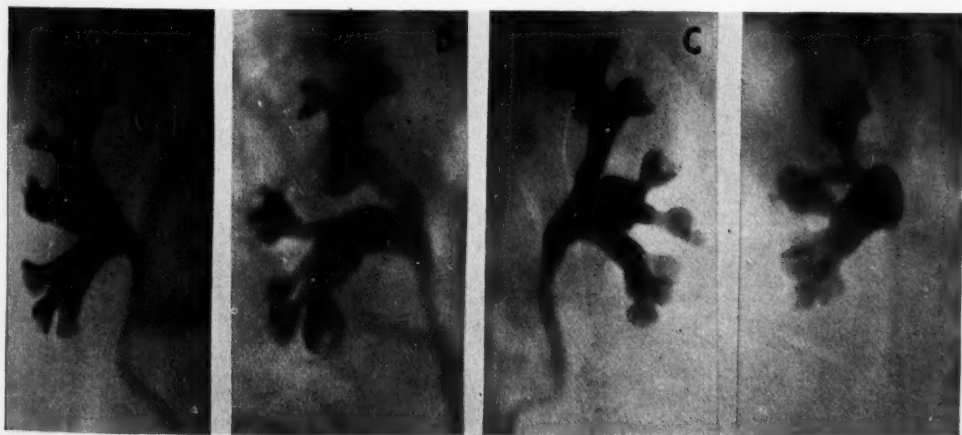


Fig. 2. Typical ampullary pelvises with well developed major and minor calyces. (*A*) Note width of necks of superior and inferior major calyces and relatively small pelvis proper. (*B*) Horizontal pelvis proper. (*C*) Unusually well developed middle calyces. (*D*) Note mode of origin of all the major calyces from dorsal aspect of pelvis, possibly due to incomplete rotation of the kidney.

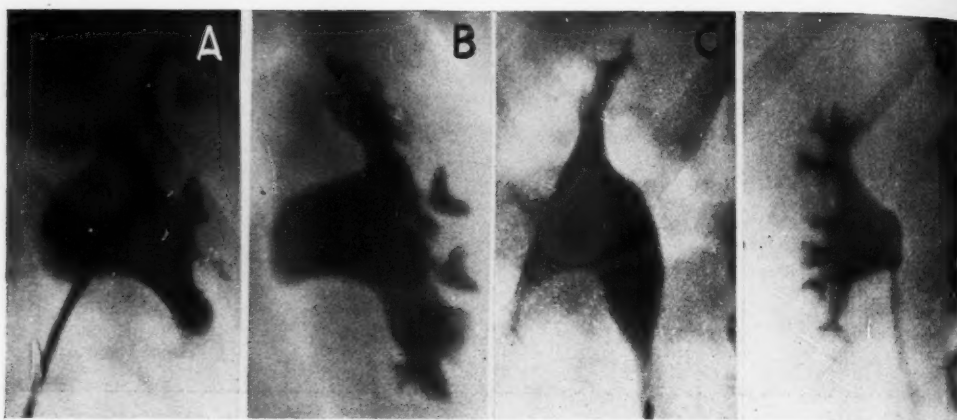


Fig. 3. Predominance of pelvis over calyces. The opposite condition is seen in Figure 4.

made, but only a pyelonephritis was found at operation. The peculiar manner in which the major calyces spread out led us to think that we were encountering a so-called spider deformity as seen in renal neoplasms.

In Figure 5 we observe a marked elongation of the cephalic (superior) major calyx in pelvis which still resemble the basic ampullary type. This long cephalic calyx is especially striking in *A*, *C* and *D*, so that in the last-named it is the predominant feature of the pyelogram. The pelvis proper

of *D* of Figure 5 is also peculiar, being very narrow and almost vertical, as seen again in *C* of Figure 10.

The transition from the ampullary type with long cephalic (superior) major calyx, as seen in *A* and *B* of Figure 6, into the much rarer bifid type (*C* of Figure 6) and from this into the group of completely divided pelvis (*D* of Figure 6) is not difficult to visualize. In the cases of complete reduplication (*D* of Figure 6), or double kidney, as it is also termed, the ureters may unite at any level from the hilus of the

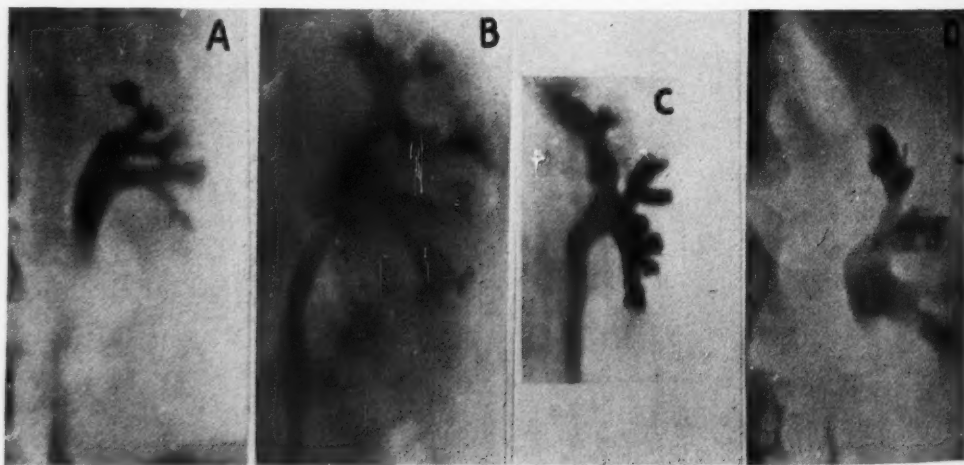


Fig. 4. Predominance of calyces over pelvis proper, the opposite condition to that seen in Figure 3. *B* is of especial interest because a neoplasm was thought of on account of the hematuria (see text). Note ureteral kink close to renal pelvis and resemblance of latter to the "pseudospider" pelvis seen in Figure 8.

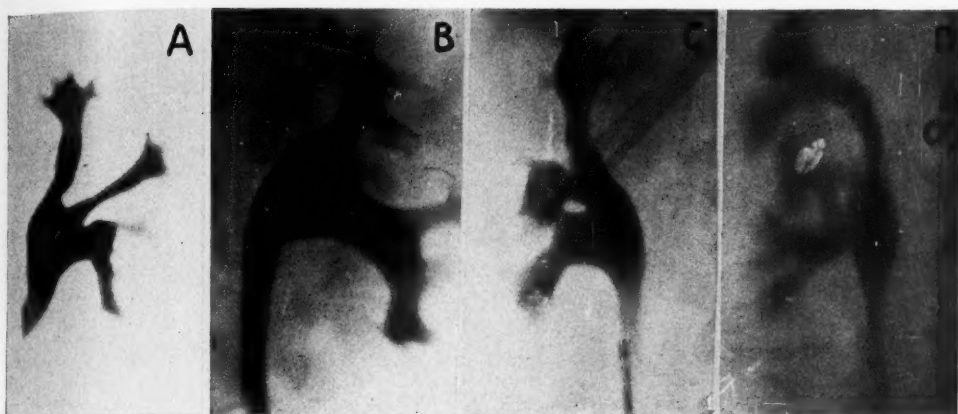


Fig. 5. Ampullary pelves with long superior major calyces. (A) Long, narrow-necked superior and middle major calyces. (B) Pelvis divides immediately into wide-necked superior and inferior major calyces. Middle major calyx arises from inferior. (C) Very wide-necked inferior major calyx and short middle, arising from superior major calyx. (D) Extremely long superior major calyx and narrow vertical pelvis. (See also C of Figure 10.)

kidney to the bladder or even remain separate so that there are two ureteral meati on the corresponding side.

In Figure 7 another variation of the ampullary pelvis is to be noted. The pelvis instead of having more or less equal horizontal and vertical diameters (as in Figure 1), reveals a predominance of the horizontal over the vertical. Owing to this, the cephalic major calyx arises much more laterally than in the classical ampullary type of pelvis. A glance at the pyelograms

in Figure 7 will show that the origin of this superior or cephalic major calyx lies so far laterally that it is only a short step until we reach the pyelogram of normal renal pelves as shown in Figure 8, which most closely resemble those of neoplasms.

This is to be seen especially well in B and D of Figure 8. The narrow horizontal pelves with the extreme laterally placed and long cephalic (superior) major calyx differ greatly from the types of pelves which we have hitherto called normal. In the case

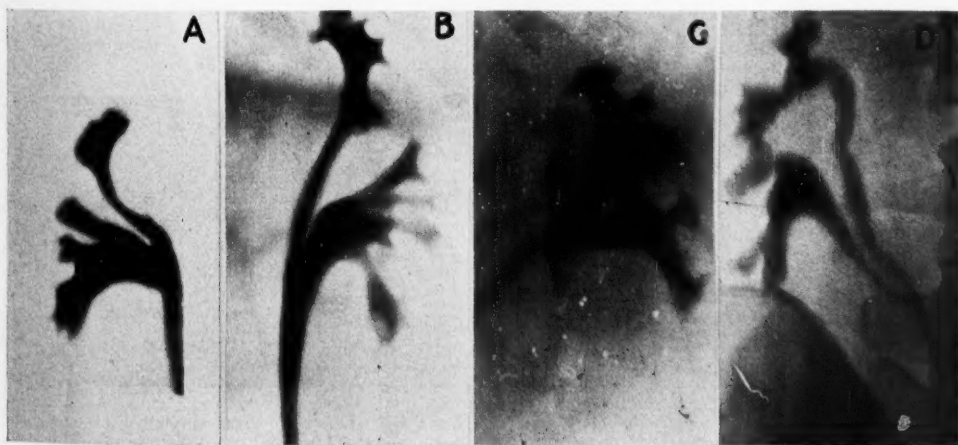


Fig. 6. Evolution of the type of pelvis which has a long superior major calyx (as seen in A and B) into the bifid pelvis (as seen in C) and then into the complete reduplication of the pelves (as seen in D).

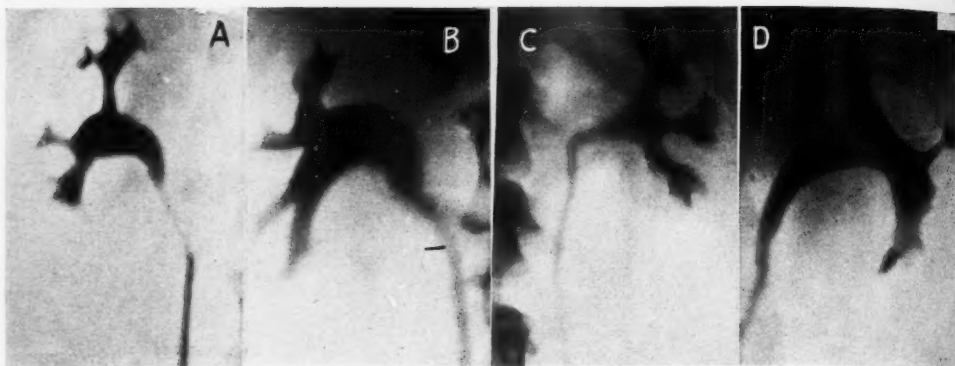


Fig. 7. Ampullary pelvises with long axes horizontal (compare with Figure 1). (B) Note how superior major calyx arises from outer (lateral) instead of superior border of the pelvis proper. (C and D) Note narrow pelvis proper.

from which C of Figure 8 was taken, there was such a persistent profuse hematuria that a diagnosis of probable neoplasm was made on account of the apparently spider-like deformity of the pyelogram. On the opposite side (B of Figure 10) there was an entirely different type of pelvis. At operation only chronic nephritic changes were found, with a normal pelvis having

peculiar branching of its calyces. In the case from which B of Figure 8 was taken, there was also a severe hematuria without a palpable renal enlargement. The pyelogram of the opposite kidney showed, however, the same mode of origin, etc., of the calyces, and hence the diagnosis was made of bleeding due to chronic nephritic changes.

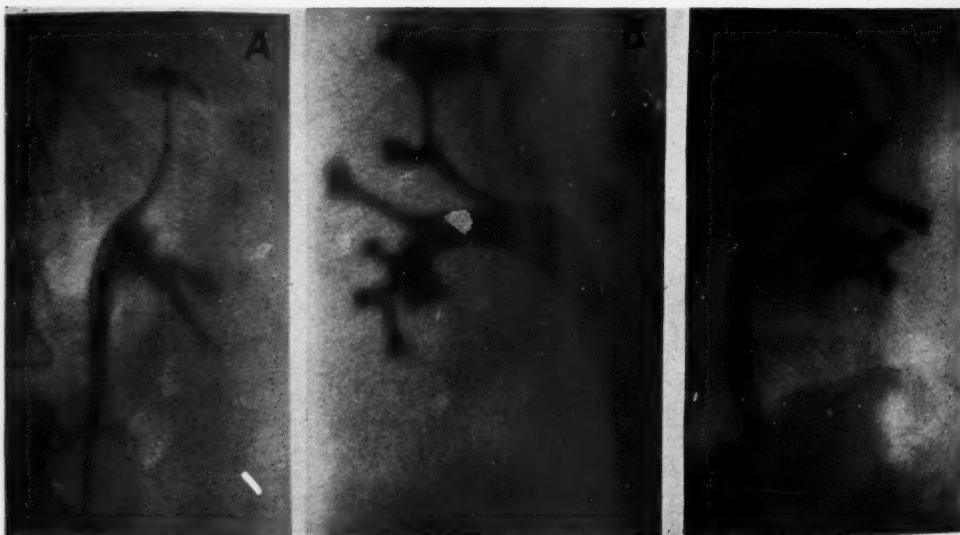


Fig. 8. "Pseudospider" types of renal pelvises. (A) Long superior major calyx, so narrow as to simulate compression by tumor or exudate (see text). (B) Horizontal pelvis with wide outlet into ureter. Superior major calyx arises from outer (lateral) border of pelvis. Long, narrow-necked superior and middle major calyces resemble pyelographic deformity of neoplasms (see text). (C) Narrow horizontal pelvis proper with inferior major arising from superior major calyx. Severe hematuria led to suspicion of neoplasm (see text).

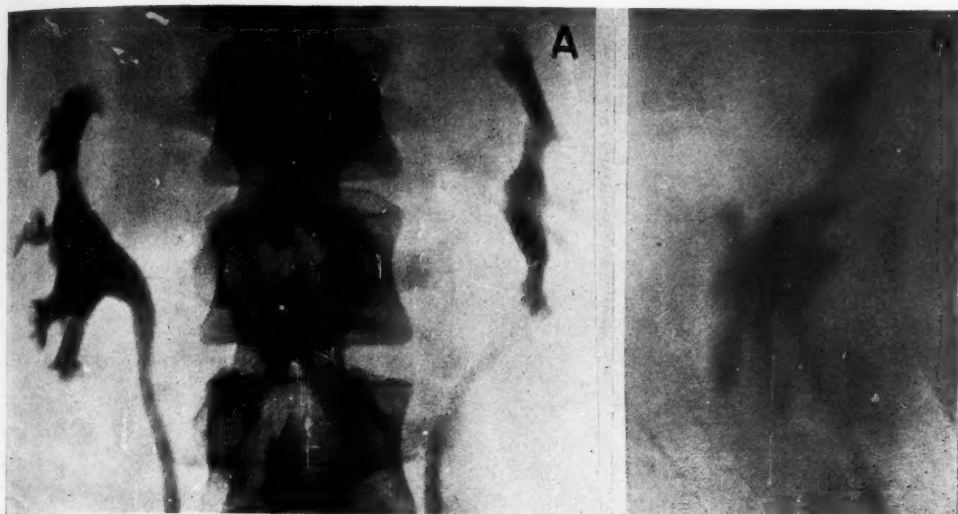


Fig. 9. Pelves in faulty renal rotation. (A) Compare normal pyelogram (right) with that of opposite non-rotated side (seen on edge). (B) Pyelogram from congenital left solitary kidney, with pelvis on ventral aspect of kidney.

We feel that this is the most important group, with which both the roentgenologist and urologist should be familiar. The close resemblance of the pyelogram to that seen in the spider deformity of neoplasm has led

us to term it the "pseudospider" type of normal renal pelvis.

Our only reasons for presenting the pyelograms of Figure 9 is to direct attention to the necessity of constantly remem-

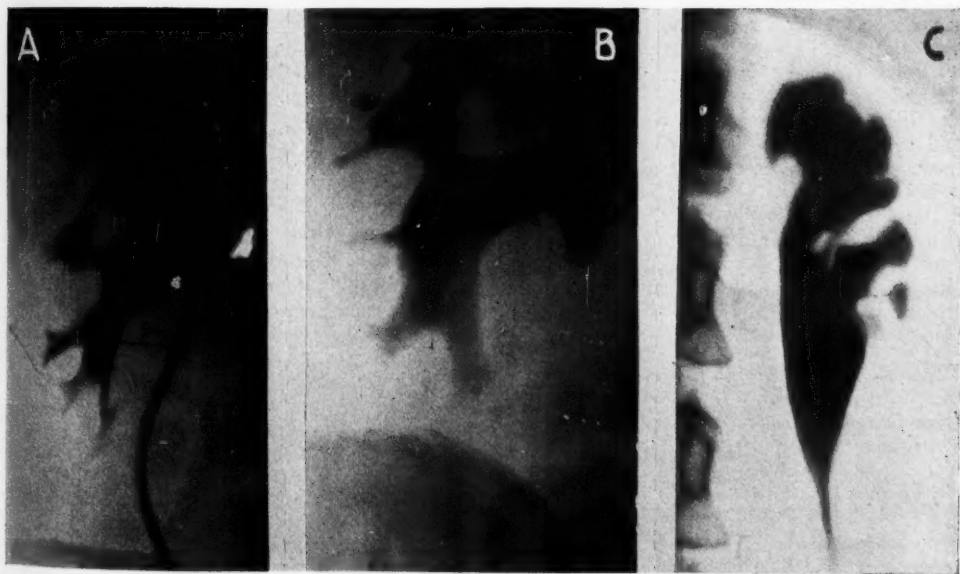


Fig. 10. Unclassified pelves. (A) On opposite side was large hypernephroma. (B) Opposite side of C, of Figure 8. (C) Almost vertical pelvis similar to D, of Figure 5.

bering that we may be dealing with a kidney on one (*A* of Figure 9) or both sides, which has not rotated completely, *i.e.*, so that its hilus faces mesially. In these cases of faulty rotation the pelvis may be seen on edge (*A* of Figure 9), or it may lie on the ventral aspect of the kidney, with its calyces directed towards the median line (*B* of Figure 9).

In the pyelograms of Figure 10 we have included those which we are unable at present to classify. *A* of this figure was of the opposite normal kidney in a case of hypernephroma showing a typical "spider" de-

formity. *B* of this figure was on the opposite side of the case in which an erroneous diagnosis of renal neoplasm was made (*C* of Figure 8). *C* of this figure is curious. The pelvis is almost as vertical as is that of *D* of Figure 5. There is a well developed cephalic (superior) and a rudimentary middle major calyx, but no trace of an inferior one.

We can only urge those who have the opportunity to study a large number of pyelograms to aid us in clarifying the question of the variations of the normal pyelogram.

Tabetic arthropathy.—The author, who records two illustrative cases, states that the incidence of bone and joint complications in tabes is estimated at 4 to 5 per cent by Marie and twice as high by Lotheissen. In both Zanolì's cases arthropathy was a very early symptom of the disease, as neither showed ataxia or disturbance of the tendon reflexes. The first patient was a man, aged 52, who had contracted syphilis at 18 and had remained in good health until 51, when, after a slight injury to the left knee, he developed a painless swelling of the joint. The suspicion of tabetic arthropathy was confirmed by changes in the pupils and superficial sensibility as well as by X-ray examination, which showed the typical appearances of a tabetic joint. Zanolì's second patient was a man, aged 33, who had contracted syphilis at 22, and, ten years later, without obvious cause, developed slight pain in the right hip, shortening of the limb, and a limp. The diagnosis of tabetic arthropathy was confirmed by the presence of typical disturbance of superficial sensibility and characteristic changes of the head of the femur on X-ray examination.

Arthropathy as an Initial Symptom of Tabes. R. Zanolì. *La Chir. degli Organi di Movimento*, Oct., 1925, p. 613. (Reprinted by permission from *Brit. Med. Jour.*, Feb. 27, 1926, p. 37 of *Epitome of Current Medical Literature*.)

Technic for non-malignant conditions.—Dr. Williams discusses the general action of X-rays in the many non-malignant conditions.

He divides his dosage into "small, heavy and large dosage." The small dosage is that of 5 to 25 ma. minutes; heavy, 50 to 100 ma. minutes and up. The other factors given are 5½-inch gap and 1 mm. Al. In other treatments the filter is up to ¼ mm. Cu. The factor of distance is not given.

F. B. SHELDON, M.D.

Radiotherapy of Non-malignant Conditions. Francis Williams. *Calif. and West. Med.*, March, 1926, p. 340.

Appendicitis complicating pregnancy.—It is well recognized that appendicitis is a dangerous complication of pregnancy. It is relatively uncommon, occurring in about 1 per cent of pregnant women. The mortality in suppurative cases is high: 30 per cent of those operated on, and 80 per cent of those not operated on. In the non-suppurative cases the mortality was 1 per cent in those operated on, and 4 per cent in those not operated on. The acute cases progress rapidly, and rupture is followed almost immediately by general involvement. In view of these facts it is recommended that appendectomy should be performed in every case in which pregnancy occurs subsequent to an attack of appendicitis. Ten cases are reported in detail.

L. R. SANTE, M.D.

Appendicitis in Pregnancy. G. D. Royston and A. O. Fisher. *Am. Jour. Obst. and Gynec.*, Feb., 1926, p. 184.

SHADOWS IN THE URINARY TRACT, FROM A PRACTICAL UROLOGICAL VIEW¹

By OWSLEY GRANT, M.D., F.A.C.S., LOUISVILLE, KENTUCKY

THE sciences of roentgenology and urology, which have as a common foundation the adaptation of principles of electricity to their separate purposes, are so closely related that I scarce feel a stranger within your gates in discussing some of the X-ray problems of urology. Nevertheless, I appreciate the honor of being asked to present for your discussion some of the difficulties that beset our common field.

So much that is technical is presented at meetings of the separate specialties that all of us are prone to forget sometimes the individual whose particular case we are considering. From our standpoint we are not only willing, but eager, to confess that any real urologist is wholly at sea without X-ray help. The ultimate beneficial result to the patient is accomplished in exact ratio as the urologist and roentgenologist work harmoniously together. These two functions cannot be combined successfully in one man, but each should have a thoroughly grounded perception of the problems of the other. Those of you who have in your communities X-ray men treating tumors of the bladder and prostate on their own or a general practitioner's diagnosis, understand quite well what I mean, and it is equally clear to you how miserable a failure is the surgeon or urologist who attempts to take and interpret alone his own X-rays.

When individual X-ray men and urologists are working constantly in unison they can accomplish all that present knowledge will permit in each case; where, however, each man is unfamiliar with the methods of the other there often occurs what might be called an "imbalance" that may be very deleterious to the patient. By this, we mean that either one or the other will have a more positive belief which will influence the man who is a partial stranger to him, and the

weaker of the two will admit a deduction, the validity of which he is not entirely convinced. We have seen wholly unnecessary and unwise surgery done by occasional operators in urology, basing their diagnosis on the *report* of a roentgenologist of high repute, which proved to be incorrect; and had the roentgenologist been more guarded in his pronouncement or the urologist more skilled in the differential diagnosis, embarrassing results might have been avoided. We call to witness two examples: one of a shadow closely simulating a stone in the bladder, unhesitatingly called a vesical calculus by the roentgenologist, which subsequently proved to be a prolapsed calcified ovary; second, a group of ten shadows diagnosed multiple calculi in the bladder, which proved to lie, not in the bladder, but in a diverticulum of the ureter. Of course, the operator should have verified his diagnosis with the cystoscope. There is no excuse for him, only chagrin in finding an empty bladder, but the cases are recited to call attention to the fact that too positive a diagnosis by a roentgenologist unfamiliar with unusual urological lesions can easily lead astray a less accomplished colleague.

On the other hand, whenever the cystoscope reveals two or more stones in the bladder we invariably have the patient radiated to determine that we have not overlooked other stones that may be present. It is not always easy to obtain a perfect view of the bladder at cystotomy, or the pelvis at pyelotomy, and it is an easy matter to overlook an unexpected calculus lying amid the folds or crevices of a collapsed viscus. For these reasons we earnestly advocate that no urological diagnosis should be made from an X-ray report alone, but that the plate itself should be studied by the urologist, and urge that the roentgenologist be circumspect in his diagnosis. The best ends will be accomplished only by two men working constantly

¹From the Urological Department, University of Louisville. Read before the Radiological Society of North America, Cleveland, Dec., 1925.

together, each noting the capabilities and limitations of the other.

The combination of these two groups is dealing with the most exact form of diagnosis at present achievable in any branch of medicine, and no case should have the stamp of definite diagnosis until every possible element of uncertainty has been eliminated. For the accomplishment of this end the *necessity of convenience is paramount*. The X-ray table must not be near the cystoscopic room, nor by it, but *in* it. It is unsurgical, incompatible with the best work of the operators, positively unjust to the patient, to have catheters put in the ureters, and then be walked about the corridors, or be lifted from stretcher to table for X-ray examination. Satisfactory X-ray cystoscopic tables almost flood the market, and patients requiring pyelogram and X-ray with catheters in ureters have a right to demand such convenience. Personally, we believe that to do pyelograms outside the hospital is dangerous for the patient, and from past experience we know it is detrimental to the urologist's sleep.

The technic of positive diagnosis of lesions in the urinary tract is best achieved with 14×17 plates. No suspected renal, ureteral or bladder lesion should be diagnosed on a plate so small as to include only a portion of the tract. Repeated exposures on small plates are more expensive and less satisfactory than a composite of the whole, and increase the time of exposure of the patient. Often it is the unlooked-for revelation of a lesion in an unsuspected part of the tract that saves a careful man from foolish error. The example of multiple calculi alone is sufficient to clinch the argument. Take big plates and plenty of them.

Calculi in the upper urinary tract present two problems:

(1) Those which show shadows on the plain plate—Are they within the urological tract or extraneous to it? The details of the procedure of this determination as achieved by the shadowgraph catheter, the double exposure and shift, the stereoscopic picture, and the ureterogram are familiar to all.

(2) The second problem is presented by patients with symptoms of renal pain and signs of obstruction or hemorrhage on passage of the ureteral catheter. So many conditions simulate renal colic due to stone that, in the absence of demonstrable shadow by the X-ray which shows so large a percentage of stones, only the wax-tipped catheter can be relied on to make the diagnosis. It is impossible for the roentgenologist to say whether a given shadow in the proximity of the ureter is in the urinary tract or not, and yet I know many general practitioners are much disappointed when they do not get a positive opinion, but to say either "aye" or "nay" is to definitely subtract from the esteem in which the mystery of X-ray is generally held, as well as often to cause grievous suffering.

The pyelogram is a study that can be read only with approximate accuracy in many borderline cases. In the diagnosis of large hydro- and pyonephroses the case is plain, but the normal pelvis varies so greatly that if the picture is not positively diagnostic, the burden of proof must rest on clinical findings. Especially is this true in cases of suspected hypernephroma. Enthusiasm for some particular kind or shape of pelvis must not lead us astray in borderline cases. Innovations are suggested constantly in refinements of diagnosis, and those that are proven finally become accepted tenets, but until they are proven it behooves us to treat them with cautious skepticism. After all, the urologist is the one who must accept the responsibility, and unless all the facts and pictures conclusively point out the diagnosis to him, no persuasion from experts should lead him astray. We believe that nothing that is not distinctly discernible on the X-ray plate, so that even the eye untrained in roentgenology can read it, taken alone or in contradiction to clinical symptoms, should serve as the basis of surgery. If plates are only partially satisfactory, for any reason, they should be repeated until they are wholly so, and no attempt should be made either by the roentgenologist or urologist to read into the plate

something that the plate does not show definitely. The pathways of urology are strewn with the tragedies of hasty decision.

The most satisfactory media for pyelograms is a solution of 12½ per cent sodium iodid in 1:3000 mercury biniodide colored with methylene blue.

The chief causes for misinterpretation of pyelograms are:

(1) Incompletely filled pelvis. This may be detected by observing the back-flow of the colored fluid along the side of the catheter.

(2) Spasm of the pelvis and ureter. Only moderate narcosis or repeated pyelograms will correct this.

(3) Deformed pelvis. Nearly all congenitally deformed pelvises are bilateral, and a pyelogram of the unaffected side will frequently present the same picture as that of the affected one, and in questionable cases the caution is a worthy one. The pyelograms should, of course, be made at separate sittings in most cases.

(4) Position. As regards the filling of the pelvis alone we do not feel that the Trendelenburg position adds any to the ease or painlessness over the supine posture. After the supine exposure is taken we withdraw the catheter to within 8 cm. of the ureteral orifice and then make a pyeloureterogram in the sitting posture. The change in the position of the pelvis in the two films is often very suggestive, and at times distinct pathologic shadows are shown in one that are absent from the other; for example, the kink in an elongated ureter with loose kidney and also the findings of partial reduplication of ureters. With regard to partial reduplication of pelvis and ureters, it is important to point out that many pyeloureterograms may show either a diseased upper or lower pole, in which case the operation of heminephrectomy—now much in vogue, and wisely so—may save much valuable renal tissue.

(5) Rotation of a normal kidney may give a very queer-looking pyelogram and the unwary may be taken in if this is forgotten.

Stricture of the ureter with reference to ureterograms is dealt with elsewhere in this symposium. There remain three other urological functions of the X-ray in doubtful cases that require no comment.

(1) The diagnosis of stone in a diverticulum of the bladder or ureter. Such stones are frequently beyond reach of the urologist's ken, and may easily escape his observation.

(2) The detection of small particles of stone at the operating table by fluoroscopy or plate. It is very difficult sometimes to locate a stone manually, without mutilation, when the kidney is pulled into the wound, and it is easy to believe that all portions have been removed though a nucleus for further trouble remains. The prompt aid rendered at the operating table by the roentgenologist in these cases is comparable to that of the pathologist with the frozen section.

(3) Many cases of neoplasm of the bladder or kidney metastasize before the patient seeks relief for his original trouble. We look to the X-ray to find these evidences of metastasis, if present, and thus avoid difficult surgery on hopeless cases.

SUMMARY

The emphasis of our thought would be on—

(1) Convenience of the two operators and the safety of the patient.

(2) The fair and not enthusiastic interpretation of a plate.

(3) The appreciation by the roentgenologist of possible explanations of shadows that may suggest further study to the urologist.

DISCUSSION

DR. ARENS (closing): There have been so many points brought out that I do not know which to discuss first. The demonstration of pathology by Dr. Nichols, which was certainly wonderful, ought to convince anyone that the normal pyelograms which were thrown on the screen were really normal. Dr. Nichols spoke about the range

of motion of a kidney. I would like to ask him what he considers the normal range of mobility of a kidney, and just how he would estimate that, so as to determine whether it is normal or pathological.

Now the question comes up, What is the value of the study of normal pyelograms? I believe it is self-evident, but it came up in the Michael Reese Hospital due to my being called upon, as roentgenologist, to pass upon many, many pyelograms in which, frankly, I could not detect the pathology. It is true there was a variation in size, a variation in shape, a variation in position, but I always recalled to mind the work of Mills on the relation of the gastrointestinal tract to bodily habitus, and it was that work which inspired us to go on and see whether or not there were the same variations in the pelvis of the kidney as there were, for instance, in stomachs in different individuals.

I want to acknowledge the absolute cooperation of the urologist, and it has certainly been a pleasure to make a combined clinical radiological study, as we have done.

Answering Dr. Grant in regard to the size of the film—that is of absolutely no consequence. Just why we should use 14×17 films and "lots of them," is more than I can understand. The essential point is to cover the urinary tract. Whether you take a film of the kidney, and another of the pelvis, or whether you use a single large film, is of no consequence, but large films are expensive and that is one thing urologists have a tendency to forget. While price is of no consideration from a scientific standpoint, yet patients must pay for those things. There is just one other item: Dr. Grant mentioned the use of the fluoroscope at the operating table. Now this is coming to be more and more widely used and advocated, but it is not a procedure to be compared to that of the pathologist who makes his frozen sections; he makes many, many of these sections, and he does it day after day. But, as a roentgenologist, I would not be able to do it for long without receiving a radiodermatitis. There is a tendency among the

men here at this meeting to consider the advisability of less fluoroscopic work—the consensus of opinion is to decrease it. As a roentgenologist I say, let the urologist fluoroscope the kidney.

DR. F. C. HERRICK (Cleveland): The great variety of renal pelves that we see pictured surprises us, and it seems unreasonable to think that we can classify them all. We well know that the urinary tract is the most common seat of congenital abnormality, and just as soon as we try to group and classify and draw conclusions, you see what a maze we are led into; we are always going to have the questionable case, always going to have the one that gives us trouble. Since I have been doing pyelographies I have looked at them from the general surgical standpoint, and I have a communication here ready for publication, so I am going to read some conclusions and show two or three slides along special lines. The slides I want to show refer to differentiation of large masses, especially gross palpable masses from tumors or masses in the kidney, which in some cases is quite difficult. I divide these into intra-peritoneal, retro-peritoneal, and intra-renal masses.

My conclusions from a large number of pyelographies of tumors are as follows:

1. A carefully made pyelograph is the most accurate evidence we possess regarding all tumors involving the kidney from within or without.
2. A coin placed over the tumor in a pyelograph aids in differentiating these masses.
3. Tumor within the kidney fragments distorts or destroys the calyces.
4. Tumor without the kidney displaces and distorts but does not destroy the renal calyces.

DR. C. G. SUTHERLAND (Rochester, Minn.): I want to speak a minute on fluoroscopy of the kidney. In our hands it has been very successful. I have fluoroscoped the same kidney five times, not more than a flash each time, but each flash revealed a shadow still remaining in the

kidney. When there was difficulty in locating the stone an assistant placed needles on three different planes, giving the surgeon a perfect location. What may appear to be one stone on the plate may turn out to be superimposed stones or stones broken in removal. To check with a plate at the completion of the observation would give an added factor of safety to which I see no objection. In well conducted hospitals and clinics, before the advent of fluoroscopy of the kidney, recurrent stones ran as high as 50 per cent. In the Mayo Clinic they were estimated at 18 per cent. Braasch believes that the greater number of these were not recurrent but stones left in the kidney by the surgeon at the time of operation. The roentgenologist should not fear fluoroscopy; it is part of his work and it should be done. Considering the patient, the screen, and the axis of the ray, he is very little exposed to the ray. I believe that the great majority of men working with the fluoroscope can do so without menace, by using all necessary precautions.

I can think of no greater co-operation between the surgeon and the roentgenologist than the use of fluoroscopy at the operating table in cases of renal stone.

DR. S. B. CHILDS (Denver): I am prompted to make a few remarks by the fact that Dr. Arens asked a question as to the normal range of the kidney in inspiration and expiration. I have been very much interested in the subject of pyelography for a number of years, and in collaboration with Dr. Spitzer, of Denver, presented a paper before the American Medical Association at a meeting in Minneapolis, in 1913, on this subject. Our object was to ascertain, if possible, a fair working basis for the size, shape and variations of the normal pelvis. I have been very much gratified to hear Dr. Eisendrath classify the slides that he has shown, for while we did not go as far as Dr. Eisendrath did, nevertheless our type of normal pelvis and calyces has been confirmed by him today. We made a pair of stereoscopic plates

with the patient in the supine position and also in the erect posture. We also made plates both at inspiration and expiration. Our number of cases was somewhat limited: we had only twenty-nine kidneys, but those, both from the clinical evidence, clinical history, urinary examination, etc., as well as by the pyelogram, were considered normal. A number of cases not considered normal were discarded from the series. The result obtained from the movement of these kidneys, the difference in the movement between inspiration and expiration, we found varied from three-quarters of an inch to an inch and a half.

I was also very much pleased to hear Dr. Lohr say what he did about kinks in the kidneys, because our conclusions were that the majority of the kinks were absolutely normal and any kidney that moves from three-quarters of an inch to an inch and a half is bound to have some kinks. There are pathological kinks, we all know, but the ordinary kink is probably normal.

DR. EISENDRATH (closing): I am very glad indeed that what we said was endorsed by all of those who took part in the discussion: I expected more of an opposition. I was especially pleased with what Dr. Grant showed us, because, with all the experience we have attempted to accumulate about normal pelves, we would have been puzzled by one slide he showed if it had not been for the fact that he told us that exactly the same type existed on the opposite side. That brings us to a point Dr. Arens and I have worked out regarding the saving of money in the matter of films, also the technic. About seven or eight years ago we did some experimental work at the Michael Reese Hospital with collargol. We showed that when one injects 30 mm., it only remains in the animal's pelvis; then when we raised the pressure to 60, we found little particles of collargol in the kidney and liver, and when we raised it to 100 mm. the animal died in four to ten minutes. The lungs were entirely black and there were collargol infarcts in the liver, spleen and brain. Now

we have discarded such toxic agents as colargol and thorium; we are using iodide of sodium, which, to my mind, is no more harmful to inject into the renal pelvis than a weak (1 per cent) nitrate of silver solution. I mention this because I cannot see the objection to doing a pyelography on both sides at the same time rather than subjecting your patient to a second examination.

Our technic has developed so that we have more or less standardized it. We take one 11×14 film for the kidney region. We next take one 11×14 of the lower urinary tract: that is all for the plain exposures. We hardly ever take a plain exposure without the X-ray catheters in place. Our second series of films are taken with the aid of the pyelographic medium. We have two persons inject at the same time who are accustomed to it and have learned to know the amount of pressure to be employed. When you encounter any resistance with your syringe, stop, whether the patient complains of pain or not. By using a small ureteral catheter, a No. 5, you cannot do any harm because whatever excess of fluid is injected into the renal pelvis flows back into the bladder. By bilateral simultaneous pyelography we have secured an exposure of both renal pelves. That is the first exposure we take with the catheters high up.

I noticed that with one of the slides Dr. Grant showed, he mentioned that he leaves his catheter in on the second exposure, 8 cm. from the junction. Our second exposure is never taken until we have pulled the catheters out completely. In that way we get a complete view of the entire course of the ureter. Rathbun, of Brooklyn, first called attention to the fact that a great many of Hunner's films of strictures of the ureter are apt to deceive, because he leaves his catheter in place in taking the films. So Rathbun was the first who pulled his catheter out entirely in taking ureterograms.

Dr. Grant made the statement, and I think it cannot be too strongly emphasized, that the man who depends upon the X-ray alone

for the diagnosis of vesical calculi, is going to be deceived. Scarcely a week passes that we do not see cases where we discover the vesical calculi through the cystoscope, and then, when we take an X-ray, it is negative. One ought to combine cystoscopy with the X-ray. We add to it cystography, filling the bladder with sodium bromide solution, 25 per cent, in order to see whether or not there are diverticula present, and whether or not the shadow of a stone that we see is lying in a diverticulum instead of in the main cavity of the bladder.

I was very much interested last Summer in some work that may also interest you as roentgenologists, in the Legneu clinic, in Paris. They are not taking films of the urinary tract; everything is being done by radioscopy of the bladder, ureter, and renal pelvis. Dr. Arens and I carried out some of their work, filling the bladder with the ordinary barium solution used in gastrointestinal work and watching that bladder fill, to see if there was any reflux present, also whether there were any diverticula, whether they emptied quickly, and their size, location, *et cetera*.

DR. NICHOLS (closing): We believe that a kidney has moved when a ureter which is apparently kinked moves down. I have no definite means of knowing just how far a kidney would move, but I think Dr. Childs has done a great deal of work on this subject. I do not know that anybody can say in a borderline case that a kidney has moved. If there is moderate obstruction in the pelvis, it is pretty certain that it is due to the ureter.

The matter of expense is about thirty cents and I do not think there should be any quibbling about this when a man is going to have his kidney removed. Many times a calculus can be localized on stereoscopic films and when this can be done it is of great assistance. Not only that, but the spine also can be examined in the stereoscopic films. Also, a shadow on one film can be compared with that on the other. The matter of expense is not important.

CARCINOMA OF THE CERVIX AND FUNDUS UTERI TREATED BY COMBINATIONS OF SURGERY, RADIUM, AND ROENTGEN RAY¹

By HARRY H. BOWING, M.D., Section on Radium and Roentgen-ray Therapy, Mayo Clinic,
ROCHESTER, MINNESOTA

A CAREFUL analytical study of the statistics now available of the results from treatment of carcinoma of the uterus definitely proves that our methods are efficient, especially in the early or operable cases. Unfortunately, however, most of the cases now observed are of the advanced type; a small number may be classified as being on the borderline. It is obvious, therefore, that our limitations in coping with the present-day problems and methods must be considered. Neither surgery nor radiotherapy alone will meet the present demands. A careful selection of patients will aid in reducing the primary surgical mortality and painful sequelæ, and improve the end-results when the treatment is surgery alone. For the remaining patients, combinations of surgery, radium and roentgen-ray treatment should afford end-results far superior to those in which only one of these methods is used. An adequate application of these three methods demands a new or practically uninvaded field of surgical and radiotherapeutic judgment in order to formulate a superior method of combating the disease.

Each procedure used alone has definite limitations when applied to combat the pathologic processes encountered in the various groups into which the cases are readily classified at the time of diagnosis and treatment. It is to be regretted that there are so few patients in the groups in which these procedures are decidedly effective. To remedy this, both patient and physician must realize that an early diagnosis is paramount. Patients must be made to understand that all types of irregular menstrual phenomena should be reported at once to their physicians. When this is done the responsibility then rests on the first

attending physician, who should make every effort known to medical science to establish, immediately, the cause for the sign or complaint registered by the patient. Even in the early groups, establishment of the diagnosis may require all the known methods. The bimanual palpation of vaginal and rectal structures is of first importance in properly classifying the patient. Visual examination of the vaginal structures will, in the majority of cases, establish the diagnosis as a malignant process. The patient should be examined in the knee-chest position, with a Sims speculum and direct light, which furnish ample exposure for the comparison of normal with the neoplastic tissues and are valuable aids in diagnosis. When the disease is beyond the vaginal face of the cervix, dilatation and curettage are necessary to establish the diagnosis.

The diagnosis of a malignant lesion by the examining physician and pathologist is not sufficient; the grade of malignancy should be estimated. The examiner can roughly estimate the grade of malignancy by the history and gross findings. High-grade malignancy is characterized by a short history and the finding of a soft medullary tumor; this is usually of rapid growth and metastasizes, or by direct extension invades near and remote tissues, early. A long history usually signifies that the disease has advanced to the inoperable stage. The low-grade malignancy is characterized by slower growing masses; they are small, firm, smooth, and usually covered with epithelium normal to the part invaded, and may or may not give an early sign. However, a microscopic examination by a trained pathologist, of the material removed, is the most reliable method by which to judge the grade of the malignancy present in a given case, and his estimation governs the procedure.

¹ Read by Dr. A. U. Desjardins for the author, at the Annual Meeting of the Radiological Society of North America, Cleveland, December 7-11, 1925.

In a general way, the management of carcinoma of the uterus is considered under carcinoma of the cervix uteri and carcinoma of the fundus. In the main, this may be attributed to the different pathologic processes rather than the different methods of treatment. Carcinoma of the cervix uteri is more malignant than carcinoma of the fundus and readily extends to neighboring tissues, whereas carcinoma of the fundus remains a local disease for a comparatively longer period. In general, primary carcinoma of the cervix is a radiotherapeutic problem, whereas primary carcinoma of the body of the uterus is essentially a surgical problem.

Owing to the limitations imposed on any procedure when used to combat this disease in all types of patients, it is essential to classify cases carefully according to the extent of the disease and also the general health of the patient. To-day it is not necessary for patient or surgeon to assume great operative risks. Radium and roentgen-ray treatment is a satisfactory form of treatment for carcinoma of the uterus since it modifies the lesion effectively and can be applied with little or no risk. As a rule, some intercurrent disease will cause the death long before the treated carcinomatous process.

In order to classify cases of carcinoma of the uterine fundus it may be necessary to employ all of the methods mentioned and also laparotomy, since clinically operable cases have been treated by radium following an abdominal incision, when exploration revealed attachment of a segment of bowel to the fundus or metastasis to glands, and so forth. If, during the course of the operation, it is found that the disease has extended farther than was revealed by bimanual palpation, the operation is terminated as an incomplete procedure. Radiotherapy makes it possible to do this, and thus the surgical mortality is decreased. At the Mayo Clinic the more radical operations are not performed.

TREATMENT

A better understanding of the effects and limitations of therapeutic rays has led to rather definite procedures, although it is impossible at the time a patient is first seen to decide how many applications of radium will be necessary. Also, there are patients with grades of malignancy that would respond to treatment, but the character of the lesion prevents adequate treatment, as it would be accompanied by trauma and unnecessary risk. These variations demand that treatment be individualized as much as possible. It is my opinion that the fractional or broken-dose method of applying radium meets this demand.

Aside from the actual treatment with radium, radiotherapeutic judgment is vital in dealing with cases. On analysis, it is complex and as difficult to attain as surgical judgment. Most patients are given a sort of mechanical treatment, for example, 50 mg. of radium for twenty-four hours, and instructed to return in six weeks. There is a factor which demands more thorough consideration,—the patient's response to a given application,—which cannot as yet be predetermined. In some cases a certain application produces marked effects, whereas in others it produces only slight effects. It would be difficult to describe the technic by which these individual variations are noted. However, some of the phases of pre-operative treatment, post-operative treatment, and non-operative treatment may be discussed.

Pre-operative treatment: The lesion to be treated pre-operatively is small and the tissues are only superficially affected. The universal silver tube applicator, with walls 0.5 mm. thick, containing 50 mg. of radium element (sulphate), is used. Para rubber tubing 1.5 mm. thick may be used as a filter. The time required for application is from ten to twelve hours and the number of applications three or four, at given intervals of three or four days, that is, two treatments a week. The interval between the first application and the operation

should be at least six weeks; in certain cases eight or ten weeks should elapse. The area should be healed and all gross evidence of carcinoma gone before operation is performed.

Post-operative treatment: To decide when post-operative treatment should be instituted depends on the operative findings. The lesion is a healing vaginal stump; it is not necessary for complete healing to have occurred. The applicator chiefly employed in these cases is the vaginal package, containing either the universal silver tube with 50 mg. of radium element (sulphate) or a brass tube applicator, with walls 0.75 mm. thick, containing 50 millicuries of radium emanation (Radon). The vaginal package is cylindrical in shape, 17 mm. in diameter, and 4 cm. long. Its outer wall is a hard rubber shell, 2 mm. thick, its inner wall a brass shell 1 mm. thick, with diameter sufficient to contain three universal silver tubes. The applicator is placed in a finger cot and tied with a linen thread to facilitate removal. The time of application varies from ten to fourteen hours, and the number of applications from two to four, depending on the size of the vaginal cavity. The same area is never exposed more than once. One area is treated at a time, the applicator being placed transversely and then diagonally in the right and left vaginal fornices directly against the vaginal wall, and the remaining vaginal wall packed off with gauze. When distance is desirable, the applicator can be wrapped with a 1 cm. thickness of gauze 2.5 cm. wide and held in position with vaginal packing. In addition, should the vaginal stump be only partly healed and the cavity large enough to accommodate the universal silver tube applicator transversely, covered with 1.5 mm. Para rubber tubing, it may be applied for ten to twelve hours.

Non-operative treatment: The lesion which is not treated by operation may be a soft, bulky, bulging cervical tumor, varying in size, with or without degenerative changes. Another variety of cervical tumor is hard and infiltrating, usually somewhat

degenerated. The crater may point toward the bladder or the rectum and represent a potential fistula. The infiltration of the broad ligament accompanying either type will vary in amount; it is usually unilateral.

Lesions of the fundus are hidden, and on account of their situation it is impossible to apply adequate or individualized treatment. Some lesions contract the uterine canal or fill it, thus making it impossible to apply adequate radiation without traumatizing the part and inviting infection and hemorrhage. I never over-traumatize a part in order to apply radium. Patients with lesions of this type should be grouped separately, as those whose lesions respond to treatment, but, because of their character, cannot be treated adequately. Usually in these cases the universal silver tube applicator containing 50 mg. of radium element (sulphate) is inserted into the substance of the tumor, or placed in the cervical or uterine canal, or crater if there is one. In the latter instance, 1.0 mm. of brass filtration may be indicated. The number of applications depends on the size and extent of the tumor, as well as the response to the treatment. The time of application is usually fourteen hours. The interval between treatments is three or four days, or two treatments a week are given. From 2,500 to 3,000 mg. hours are delivered to each 2.5 cm. thickness of diseased tissue, although for bulging, bulky, soft cervical tumors the total number of milligram hours may be greater. Such tumors are reduced by the rays of radium rather than removed surgically with a curette or cautery. After the bulky tumor has been reduced it is usually possible to locate the cervical canal. For example, when the anterior 2.5 cm. thickness of tissue is exposed to the 2,500 mg. hour treatment, the second 2.5 cm. thickness may be reached. The probing must be gentle, since the diseased area is easily punctured. At this stage it may be impossible to pass the probe beyond the internal os, in which event the treatment is discontinued. However, should the probe pass beyond the internal os, a tandem of

two or three universal silver tubes, each containing 50 mg. of radium element (sulphate), is held in this relation by placing the tubes in a Para rubber tube, with walls less than 1.0 mm. thick. The rubber is not intended as a filter but facilitates the introduction of the silver tubes. The amount of time allowed for this application depends on the amount of infiltration of the broad ligaments. For bulky infiltrations the limit is twenty hours, whereas the limit for the slightly infiltrated broad ligaments is ten to twelve hours.

The vaginal package is used as for post-operative treatment. Sometimes, in order to reach all vaginal lesions, it may be necessary to treat more areas. The applicator may be placed longitudinally or in the axis of the vagina in median and anterior positions. Care should be taken, when the anterior treatment is given, that the external genitalia are packed away with gauze. When the perineal floor is relaxed the packing may be supported by placing adhesive plaster strips, 15 to 20 cm. long, diagonally across the perineum. One strip should be fixed on the right half of the pubic promontory and across the perineum to the opposite buttock, and the other fastened to the left half of the pubic arch and right buttock. The strips should be so placed as to furnish as much support as possible to the perineal floor.

If the lesions have been modified by inadequate procedures, the applicators just mentioned as well as steel alloy needles, each containing 5 or 10 mg. of radium element (sulphate); platinum-iridium needles, each containing 1 mg. of radium element (sulphate), or glass seeds, each containing less than 1 millicurie of emanation (Radon), are buried into the vaginal masses in an attempt to distribute the therapeutic rays equally throughout the tumor. The time consumed in the application is eight, ten, twelve, or fourteen hours, depending on the selection of the applicator, its radium content, and the bulk of the tumor. The rule is never to repeat the non-operative treatment; it is, therefore, important that

the first treatment series be sufficient to obtain the ultimate good. If the general health of the patient is undermined, only limited treatments are given, or a cautious total of 1,500 or 2,000 mg. hours.

The knee-chest position, Sims speculum and a direct light are used as aids in diagnosis and in giving radium applications. For packing purposes a moist sterile bandage, 5 cm. wide, is employed.

In practically all cases a biopsy is made at the time of the first or second application of radium and the malignancy graded. This information is important in deciding on the best procedure to combat the disease. In cases in which hemorrhage or infection seems to be an inevitable serious complication, material is not removed for biopsy.

ROENTGEN-RAY TECHNIC

In the post-operative cases when prophylaxis is indicated the abdominal wound should be healed. When radium is to be applied it should precede treatment with roentgen rays. Each operator must standardize his equipment. The standard dose factors used in treating the majority of patients at the Mayo Clinic are: kilovolts, 200; milliamperes, 5; distance, 50 cm.; filtration, copper 1.0 mm., aluminum, 1.0 mm.; time, one hour and forty-five minutes for each of 6 areas; size and location—one anterior 20 by 20 cm., one posterior 20 by 20 cm., two lateral (right and left) 10 by 20 cm. One area a day is exposed until the total treatment is given. The standard dose should be changed to suit the needs of the patient. For a small individual it should be: filtration, copper 0.75 mm., aluminum, 1.0 mm.; time, one hour and fifteen minutes, or one hour and twenty minutes. Treatment may be repeated after six or eight weeks.

In selected cases, especially those in which the patient's health has become undermined (and usually much local infiltration is found), the following factors have afforded greater palliation: kilovolts, 200; milliamperes, 5; distance, 50 cm.; filtration, copper 2.0 mm., aluminum, 2.0 mm.;

time, three hours for each area; number, size and location of areas standard. Each area is exposed twice, that is, one and one-half hours at a time until all are exposed for the allotted time. Treatment may be repeated after intervals of six and eight weeks, depending largely on the response to the first exposure. Since palliation only is to be expected when these special treatment factors are employed, the advisability of repeating the treatment should be questioned. This technic is on trial and to-day it is used only in exceptional cases.

CLASSIFICATION OF CASES

Carcinoma of the uterine fundus: Cases of carcinoma of the uterine fundus may be classified as operable, borderline, inoperable, recurring, and modified. In the operable group the uterine fundus should be freely movable. Bimanual pelvic examination is essentially negative. In the borderline group there is a questionable degree of fixation or questionable extension of the disease to the vaginal face of the cervix. Adhesions from an old pelvic inflammation must not be confused with adhesions as the result of malignant lesion. In the inoperable group there are definite fixation and gross metastatic lesions. In the recurring group are the cases with operable lesions in which a recognized surgical procedure has been previously performed. In the modified group are the cases which were inoperable and in which some type of incomplete procedure has been attempted.

A policy worthy of consideration in the management of carcinoma of the fundus would be as follows: In Group 1, total abdominal hysterectomy alone should be done if the lesion proves to be confined to the superficial tissue of the wall of the fundus and of Grade 1 or 2 malignancy, whereas, should it prove to be of Grade 3 or 4, regardless of the apparent extent of the lesion, prophylactic post-operative treatment with radium and roentgen rays is also indicated.

Pre-operative applications of radium are indicated in Group 2, and sufficient time,

usually several weeks, should elapse before operating, to insure the maximal tissue response. The suspicious areas or the infiltration should reduce in size and extent, thus definitely decreasing the surgical risk and permitting a conservative surgical procedure to be employed. Regardless of the grade of malignancy, post-operative treatment with radium and roentgen rays is indicated. In Group 3, radium and roentgen-ray treatment is preferred. When the general health is good, intensive treatment should be employed. Should the general health be undermined, either by the malignant condition or other breaks in vital body structures, the treatment should be cautious or moderate. In Groups 4 and 5 radium and roentgen-ray treatment is indicated. In the former group, provided the recurrence is early and efficient treatment is instituted at once, a very good result may be anticipated, whereas in the latter only cautious treatment should be given, since the disease may be only further arrested.

Carcinoma of the cervix uteri: Carcinoma of the cervix uteri can be classified similarly, since all procedures are governed by the extent and grade of malignancy. In Group 1, with early or operable lesions, the disease is limited to the tissues of the cervical canal. In Group 2, the borderline cases, the disease is limited to the vaginal face of the cervix. In Group 3, the inoperable cases, there has been extension of the disease to the vaginal walls, broad ligaments, and so forth, and some degree of fixation of the cervix. In Group 4, the recurring cases, only those are included which were operable at the time of intervention, and in which thorough operations were performed. In Group 5, with modified lesions, the cases were inoperable at the time of treatment and the procedures employed were incomplete, such as incomplete operations, one or more applications of actual cautery, or insufficient radiotherapy.

For Group 1, total abdominal hysterectomy is indicated. Should the disease be limited to the superficial tissues of the cervical canal and the malignancy be Grade 1

or 2, the necessity of post-operative radiotherapy is questionable; however, should the malignancy be Grade 3 or 4, regardless of size or extent, post-operative radiotherapy is indicated as a prophylactic measure. In Group 2 pre-operative applications of radium are indicated, regardless of the grade of malignancy. A sufficient time interval should elapse,—several weeks,—before surgical intervention is instituted. The part treated should be healed and there should be no gross evidence of malignancy. Post-operative radiotherapy also is indicated. In Group 3, non-operative, radiotherapy alone is indicated. If the general condition of the patient is good, the maximal amount of treatment should be given. Should the health be undermined, regardless of the underlying factors, only cautious radium treatment should be applied; roentgen-ray treatment should be considered. In Group 4, non-operative, radiotherapy is indicated, and when it is sufficiently applied to small areas of activity the prognosis is very good. In Group 5, non-operative, ra-

diotherapy is cautiously applied, since by this method it is possible further to arrest the disease.

SUMMARY

All patients complaining of an irregular menstrual bleeding or vaginal discharge, regardless of its character and age of the patient, are deserving of our best endeavors to make an early diagnosis. All patients should be instructed concerning the gravity of the apparently insignificant signs, which are usually associated with early phases of the disease, in order that they may understand the importance of being examined as soon as possible following the onset. Surgery, radium and roentgen-ray treatment, in various combinations, is the most efficient method of combating neoplastic disease of the cervix and fundus uteri. This treatment, to be efficiently directed and applied, demands the most diligent cooperation on the part of the first examining physician, surgeon, pathologist and radiotherapist.

THE RELATIVE VALUE OF VARIOUS TECHNIQS IN THE RADIATION TREATMENT OF CARCINOMA OF THE BREAST, AS REFLECTED IN THE STATISTICAL ANALYSIS OF 701 PRIVATE CASES, WITH OBSERVATIONS AS TO THE GENERAL VALUE OF RADIATION¹

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IN a previous paper presented by the authors before the annual meeting of the American Roentgen Ray Society, September, 1925, at Washington, D. C., a review was made from a statistical standpoint of the results obtained in the treatment of carcinoma of the breast. The length of this paper prevented a discussion of the technic in relation to these results. It seemed, therefore, appropriate that this phase of the subject should be discussed in relation to these statistics before this body.

During the past twenty-five years Dr. Pfahler's technic in the treatment of carcinoma of the breast has, of course, varied with the developments of the subject. The early cases were treated with unfiltered rays by fractional doses, often repeated; generally when active disease was present, six times a week, and when less active, three or two times a week. Each dose represented, as nearly as one could estimate to-day, approximately one-tenth or one-eighth of an erythema dose. The treatments were continued until an erythema was obtained, and the intervals, then, between treatments increased so as to retain the erythema but not exceed it. In post-operative cases this was usually continued during a period of about two months. In the active recurrent or advanced primary carcinoma it was continued according to the therapeutic effects obtained, but generally many months.

In September, 1905, Dr. Pfahler described the use of a sole-leather filter, and so far as is known this was the first filtration used in roentgen therapy in the treatment of carcinoma. This filter was described before the American Roentgen Ray Society at its annual meeting in September,

1905, at Baltimore, Maryland, and again described and demonstrated with experimental evidence before the annual meeting in Niagara Falls, 1906. At this same time, the use of a silver filter was suggested by Dr. Pfahler. The "protecting shield," used with this filter, had been described previously in the *Philadelphia Medical Journal*, Feb. 14, 1903. From 1905 forward the leather filter was used in all breast cases, and the clinical impression obtained was that a great improvement in technic had been made. The leather filter was gradually supplemented by a millimeter of aluminum, and the effects of this aluminum filtration were further studied and described before the American Roentgen Ray Society, in 1912, giving the relative values of various thicknesses of filter and of increased spark length, but at least over a period of 1910 to 1922 there was a gradual increase in the filter value, using, during most of this time, from 4 to 6 mm. aluminum.

At the beginning of 1922 high voltage rays with 0.5 mm. copper filter were used, and this quality of ray has been used, for the most part, since that date. The general impression is that there has been an undoubted improvement in the results obtained with each advance in technic.

In the earliest work, up to 1905, the treatment was given chiefly over the operative field, without definite limitations of the area involved, so as to take in practically the entire side of the chest on which the carcinoma was found.

Between 1905 and 1910 cross-firing was developed, delivering the rays into the mammary region, the axilla, and the supraclavicular region.

About 1910 these fields were more definitely outlined, using a general field over the mammary region, one immediately

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above this, extending to the clavicle and taking in the coracoid region, another field used in the axilla, one in the scapular region and one in the supraclavicular region. Treatment was given through each of these fields up to an erythema dose, either in daily treatments or with treatments given three times a week, one dose in each of these fields given on any one day; and then an interval of four weeks was allowed to pass, after which this application of rays, filtered through 6 mm. aluminum and using a 9-inch spark gap, was repeated. Generally four to six series of doses were given to a patient during eight months to a year, after which no treatment was given unless evidence of disease was present.

In 1922, with the use of the high voltage and highly filtered X-rays, larger fields were used, taking in the entire mammary region and extending to the clavicle, anteriorly and posteriorly, and in some instances adding a special dose through the supraclavicular region. This was given within one to three days and no further treatment was given during a period of two months. This produced a tremendous amount of radiation sickness and the results did not seem to be so satisfactory. We have now, therefore, modified this technic to use the low voltage rays, 9-inch spark gap, with 6 mm. filter, over the general mammary region, directing the rays through the chest. We then give high voltage rays through the axilla, directed toward the upper mediastinum and supraclavicular region; a third field of rays is given over the subcoracoid region, into the lymphatics, extending from the axilla to the clavicle and directing the rays backward and outward, keeping clear of the lung tissue, and a fourth field of rays directed through the supraclavicular region toward the upper mediastinum. If there is suspicion of involvement of the upper mediastinum, an additional beam of rays is directed either through the anterior mediastinum or through the posterior mediastinum. Each dose given, depending upon the condition of the patient and the circumstances, varies from 50 to 80 per cent, and,

when possible, radiation is given daily; when this is impractical, three times a week or twice a week. As the fields are covered a second time in post-operative cases, the dosage is brought up to 100 per cent of an erythema dose on the basis of the saturation charts, previously described (Pfahler: International Congress of Radiology, July 1 to 4, 1925, London, England). We aim to cover each field four times in this manner. We are not sure whether it is advisable to give this radiation in succession; that is, within a period of a month, or whether it is better to allow an interval of a month, then give the second half of the treatment after such an interval. We aim not to produce radiation sickness. We try not to distress the patient by over-radiation. We avoid, when practical, radiation through the pulmonary tissue, excepting so far as is absolutely necessary to reach the mediastinum. This effect on the mediastinum can be obtained, however, without much effect on the pulmonary tissue, if one radiates toward the group of lymphatics, around the border of the lungs, rather than directly through the lungs. We are convinced from our clinical observations that we are obtaining to-day better results in the treatment of carcinoma of the breast than we have obtained by any other treatment. In the treatment of primary disease, one must, of course, be guided by the conditions present, obtaining a cross-firing effect so far as possible, and making a careful estimation of the extent of the disease at the beginning of treatment. This involves, in all instances, a roentgen-ray examination of the chest, and it is advisable, in all advanced, primary cases, to also make an X-ray examination of the liver, spleen and spinal column. Frequently it will be found that advanced disease is present in these organs, when not suspected.

It is difficult, or, in fact, impossible, to evaluate the advantages of one technic over another in terms of figures or percentages.

1. The various technics have marked a gradual development, and therefore the improvements were taken advantage of,

TABLE I

CLASSIFICATION OF TYPES AND EXTENT OF INVOLVEMENT IN 701 PRIVATE OFFICE CASES

a. Both Pre-operative and Post-operative Treatment

	Group	Before operation: Glands	After operation: Glands	No. cases	Per cent
A	I	No	No	8	18
B	II	Yes	No	24	56
C	IV	No	Yes (Not removable)	2	5
D	IV	Yes	Yes (Not removable)	9	21
Total				43	6

b. Post-operative Treatment

E	II	Yes	No	86	49
F	IV	Yes	Yes	63	36
G	I	No	No	22	13
H	IV	No	Yes	3	2
Total				174	25

c. Recurrent Cases

I	III	Local recurrence	13	4
J	IV	Local rec. glands ax. and sup. cl. regions	43	15
K	IV	No loc. rec., metas. Mediastinum—lungs	13	4
L	IV	Loc. rec. ax., sup. cl. and mediastinal	199	67
M	IV	No loc. metas. to spine and other bones	7	2
N	IV	Metastasis—mediastinum, lungs and bones	23	8
Total			298	43

d. Primary Inoperable Cases

O	IV	Fix. sk. or ch. ax. s.c.l. and medias. dis.	117	82
P	IV	Fix. sk. or ch. ax. s.c.l. plus bone metas.	5	3
Q	IV	Made operable without chest metas.	13	10
R	IV	Made operable with chest (palliative)	5	3
S	IV	Removed by electrocoagulation	3	2
Total			143	20

e. Primary Operable Cases

V	I	Prim. operable (refused or phys. not fit)	43	6
T	I ²	Prim. operable. Questionably malignant	12 (or 2 per cent)	
Total			701	

The groups under each sub-division are classified after the fashion of the generally accepted surgical tables.

Group I	Early operable—no glands involved.
Group II	Late operable—with glands involved.
Group III	Local recurrence—operable.
Group IV	Inoperable—primary and secondary.

even in the treatment of an individual patient. Only a general idea can be formed, on this account, by comparing one period with another. We believe that our clinical impressions are probably of more value than cold figures, as will be illustrated later.

2. The variability in the character of cases referred for treatment during any one

year makes it impossible to compare with those of another year. With each improvement in technic greater hopes are aroused, on the part of both the radiologist and the general clinician. Therefore, the tendency is to refer more and more advanced cases with each improvement announced.

It will be seen in Table I that in the Pre-operative and the Post-operative Group (a) glands were involved in 35 cases, or 82 per

²Two died: fulminating metastasis following operation.

TABLE II
DURATION OF LIFE AFTER BEGINNING TREATMENT (TABLE I)
(590 CASES — 1900-1922)

a. Both Pre-operative and Post-operative Treatment

A	Group	Mo. Mo.		Number Years Alive																		Total					
		6	8	1	1½	2	2½	3	3½	4	5	6	7	8	9	10	11	12	13	14	15		16	17	18	19	20
A	I									1	1	3	2													1	8
B	II									3	2	1								2							13
C	IV									1																	1
D	IV	1			3				2	1		1	1														9

b. Post-operative Treatment

E	II		3	6	4	7	3	6	6	2	10	5	1	2	1	3	1	2	1	1	1	1	1	1	1	1	68
F	IV	2	6		12	3	1	5	1	2	4	4				1	1	1		2	2	1	2			51	
G	I	1			1	1		1			3	2	4			1				2	2	1	2			22	
H	IV				1			1															1			3	

c. Recurrent Cases

I	II	1	1	2	2	6	1	2	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13
J	IV	1	1	4	4	3	1	3	1	4	1	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	32
K	IV	1	1	1	1	3	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	10
L	IV	20	27	31	8	21	1	18	17	14	11	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	175
M	IV	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5
N	IV	8	6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17

d. Primary Inoperable Cases

O	IV	10	12	13	8	11	5	10	7	6	3	4	2	2	1	2	3										102
P	IV	2			1	1	1																				5
Q	IV	1		3					2		1				1										1		13
R	IV	1		1				1																			4
S	IV							1																			2

e. Primary Operable Cases

V	I		1	1	1	1	2	4	1	1	4	2	2	1	1	2	1	1	3	1							29
T	I							1	1	1	1	1	1	1	1	1	1	1	1	1							8
		38	64	76	42	55	21	60	38	37	44	23	11	8	7	12	9	4	12	10	5	4	2	4	1	3	590

Table II itemizes the duration of life of each group according to the classification shown in Table I. The duration of life of all cases in all groups is summarized in Table III for the 3- and 5-year periods.

cent, leaving only 8 cases, or 18 per cent, with no gland involvement.

In the Post-operative Group (b) glands were involved in 152 cases, preceding operation, or 86 per cent, leaving 22, or 13 per cent, with no gland involvement. Considering the three groups (A-G-V) it will be seen that only 71 cases, or 10 per cent, of the total of 701 cases in our previous records came under treatment before glands were palpable.

In the Recurrent Group (c) 199, or 67 per cent, showed axillary, supraclavicular and mediastinal disease.

In the Primary Inoperable Group (d) of 143 cases, 107, or 71 per cent, showed demonstrable X-ray evidence of metastasis in the chest at the beginning of the X-ray treatment; while 5 cases, or 3 per cent, revealed bone metastasis.

In the Primary Operable Group (e), 43, or 6 per cent, received radiation treatment without operation. These cases refused operation or were physically unfit. Twelve, or 2 per cent, were questionably malignant. In all instances surgery was advised. Two of the questionable cases went to operation at three and five months after our first examination, and both died of fulminating metastatic carcinoma within six months. These cases seemed to develop rapidly before treatment, and were held at a standstill only by treatment.

ESTIMATION OF LIFE IN MAMMARY CANCER WITH RADIATION THERAPY

We have classified these cases in the above table in such manner that they can be compared with surgical treatment, and with no treatment, with regard to the total duration of life from the beginning of the disease.

When a patient was no longer traceable we recorded the case as having lived so many years—to the time of the last record. Every case is entered, and every patient who applied for treatment is included in the statistics, whether the patient was treated, refused to complete treatment, was hopeless from any standpoint of treatment,

or the records were incomplete because we could not follow the case to its termination. We therefore automatically recorded a case as dead when no longer traceable. This, however, has not always been the case and may not give radiation its full value, because frequently some of these cases will turn up for inspection several years later, free from all palpable evidence of the disease. We believe this will balance any discrepancies that might be weighed against the element of the personal equation in interpreting end-results in this study. Twenty cases were so far advanced that no treatment or only a partial series of treatments was given. These cases averaged a life of from three to five months from the time of our examination, and consequently reduced the total values.

TABLE III
TOTALS OF TABLE II—THREE- AND FIVE-YEAR AVERAGES

a. Both Pre-operative and Post-operative Treatment

		Total	Alive 3 years	Per cent	Alive 5 years or more	Per cent
A	I	8	7	87	3	37
B	II	13	10	77	7	54
C	IV	1	0	0	0	0
D	IV	9	3	33	1	11

b. Post-operative Treatment

E	IV	68	45	66	31	45
F	IV	51	22	43	14	27
G	I	22	18	81	17	77
H	IV	3	2	66	1	33

c. Recurrent Cases

I	III	13	9	69	7	54
J	IV	32	19	59	8	25
K	IV	10	4	40	2	20
L	IV	175	67	38	18	10
M	IV	5	2	40	0	0
N	IV	17	1	6	0	0

d. Primary Inoperable Cases

O	IV	102	43	42	20	19
P	IV	5	0	0	0	0
Q	IV	13	8	69	6	46
R	IV	4	1	25	0	0
S	IV	2	0	0	0	0

e. Primary Operable Cases

V	I	29	24	82	19	65
T	I	8	8	100	6	75
		590	293	50	160	27
V and T		37	32	86	25	68

For comparison with the usual surgical longevity tables the following grouping quickly summarizes the radiation values:

Group—	Total cases	Alive 3 years	Per cent	Alive 5 years	Per cent
I Early operable—no glands.....	67	57	85	45	68
II Late operable—with glands.....	81	55	68	38	46
III Recurrent operable	13	9	69	7	54
IV Advanced recurrence and metastasis and primary inoperable	429	172	40	70	16
Total	590	293	50	160	27

Of all cases, early and late, operable and advanced, inoperable and recurrent, 50 per cent were alive 3 years, and 27 per cent were alive 5 years or more.

In the Post-operative Group (G), without gland involvement, 81 per cent were alive 3 years, and 77 per cent were alive 5 years or more.

In the Post-operative Group (E-F-H), with gland involvement, 56 per cent were alive 3 years, and 38 per cent were alive 5 years or more.

Of the cases receiving both pre-operative and post-operative treatment (a), without gland involvement, 87 per cent were alive 3 years, and 37 per cent were alive 5 years or more. These cases had advanced ulcerating local disease.

In the Pre-operative and Post-operative Group (B-C-D), with gland involvement, 30 per cent were alive 3 years, and 18 per cent were alive 5 years or more. The records of (B-C-D) show advanced cases, and operations and X-ray treatment in many instances were intended only as palliative. Many of these cases to-day would be classed as "totally inoperable." This explains why the percentages are lower than when only post-operative treatment was used.

The Local Recurrent Operable Group (I) shows 69 per cent alive 3 years, and 54 per cent alive 5 years or more. This observation is important to contrast with the usual experience of fulminating recurrences and metastasis which are so frequent after excision. In our group of recurrent cases (c) there were:

34 cases with histories of one operation before coming to us.

19 cases with histories of two operations before coming to us.

8 cases with histories of three operations before coming to us.

5 cases with histories of four operations before coming to us.

4 cases with histories of five operations before coming to us.

70

Ewing states that statistics favor the conclusion that operation, on the whole, shortens life in the recurrent cases and in the great majority aggravates the suffering.

In the Advanced Recurrent and Metastatic Group (J-K-L-M-N), out of 239 cases, 93, or 38 per cent, were alive 3 years, and 28, or 12 per cent, were alive 5 years or more. These cases as a whole were so advanced that practically they may be considered as being in the terminal stages of the disease at beginning treatment. The above group of 70 cases with repeated rapid recurrences following operation is an example of the late stage of the disease in which they come for radiation treatment. Of these 239 cases, 216, or 90 per cent, showed demonstrable X-ray evidence of mediastinal metastasis at the beginning of X-ray treatment. The average life of this group after commencing X-ray treatment was 2 years and 9 months (Table II). If we add to this the average time from operation to recurrences, which was 1 year and 4 months, we have a duration of life of 4 years and 1 month from

the time of the operation. The average time from the discovery of the lump to operation was 1 year and 5 months, making a total duration of life from the first recognition of the disease to its termination of 5 years and 6 months in these advanced, recurrent and metastatic cases. This estimation included 20 cases in which the disease was so far advanced that no treatment was given or only slight treatment as a placebo, also 67 cases in which radiation could not be properly given. If these were eliminated, the average life after treatment would be approximately 3 years.

The Advanced Primary Inoperable Group (O-P-Q-R-S) show, in 126 cases, 41 per cent alive 3 or more years, and 20 per cent alive 5 years or more. Ninety-three cases, or 73 per cent, of this group showed demonstrable X-ray evidence of metastasis in the chest or bones, at the beginning of treatment, yet the average duration of life from the beginning of X-ray treatment was 3 years and 4 months (Table II). The time from the first recognition of the disease to X-ray treatment, in this advanced group, averaged 21 months, in 143 cases so analyzed. Therefore, with radiation treatment we have a duration of life from beginning of the disease to its termination, in this advanced inoperable group, of 5 years and 1 month, or 61 months. Lee and Herendeen, in 57 cases which they class as "less advanced primary inoperable" carcinoma of the breast, find an average duration of life from the time the growth was discovered

to be 4 years, or 48 months, with proper radiation. Finney, in Keen's "Surgery," gives the average duration of life in the untreated cases as 20 to 28 months from the beginning of the disease. Sprengel, Odekop, Sibley, and Paget, quoted by Ewing, have estimated 27, 29, 34 and 48 months, respectively, as the duration of life in the cases not operated upon.

Thirteen cases (1.3 per cent) of our Inoperable Primary Group, with no demonstrable mediastinal disease, became operable under radiation and give an average life of 6 years.

In the early Primary Operable Group (V-T), 37 cases, or 86 per cent, were alive 3 years, and 68 per cent were alive 5 years or more from radiation treatment alone. This group flatly refused operation, or there were surgical contra-indications to operation. Eight cases, or 2 per cent, of this group (590 cases) might be regarded as questionably malignant, but the clinical course in all instances would have warranted operation.

An analysis of Tables II and III indicates very clearly the great advantage of radiation therapy in carcinoma of the breast: not only as an adjunct to surgery, but in the hopeless recurrent and inoperable cases. A relative comparison with the surgical groupings is possible only in the operable cases.

Table IV shows that surgery of various clinics report from 46 to 100 per cent in the early operable cases, and from 4 to 39

TABLE IV
COMPARATIVE VALUES OF OTHER CLINICS AND METHODS (OPERABLE CASES)

		Alive 3 years		Alive 5 years	
		No glands	With glands	No glands	With glands
Greenough	Surgery	47%	19%		
König	"			100%	39%
Bloodgood	"			70%	20%
Lee	"				15%
Finsterer	"				4.3%
Doederlein	"			46%	5%
"	" and radiation		not completed	48%	20%
"	" " "		totally completed	80%	36%
Wintz	" " "		both groups 77%	48%	
Schmitz	" " "			64%	42%
Pfahler and Widmann	" " "			68%	46%

per cent in the cases where the glands are involved. Ewing believes that 4.5 per cent for 5-year cures represents the average success obtained by surgical treatment. Seuffert, Schmitz, Pfahler and Widmann show 36, 42 and 46 per cent, respectively, in the radiation of cases showing gland involvement.

The recurrent cases with glandular and mediastinal metastasis show a post-operative life of 49 months with radiation. Handley and Greenough report an average life of 29.6, and 25 months, respectively, in the late cases with surgery alone. From first recognition of disease, the average duration of life with radiation in this recurrent group is 5 years and 6 months.

The inoperable primary cases show an average life of 5 years and 1 month, against 27, 29, 34 and 48 months in untreated cases reported by Sprengel, Odekop, Sibley and Paget.

In addition to increasing the duration of life, we, as well as others, have repeatedly demonstrated the definite value of radiation in advanced cases. The palliation, retardation and relief of suffering can be appreciated only by those who live in this work.

Murphy, Nakahara, Nogier, Jaubert, Colwell, Chambers, Wedd, and Russ, as well as many others, have adduced sufficient experimental data to establish radiation treatment as of value in conjunction with breast surgery. Everyone recognizes the value of radiation treatment in the advanced case. Why should it not be of value in the early case?

The great variation of response to treatment in many of these cases may be explained by the investigations of Broders and MacCarty on cell differentiation (lymphocytic infiltration, fibrosis, hyalinization and cellular differentiation). It is suggested that these factors play a significant rôle in the defensive mechanism against cancer, and recently these writers applied this method in a study of the longevity of cancer patients. It is possible that radiation may produce just such alterations in the tis-

sues as has been demonstrated recently by Ernst and his co-workers.

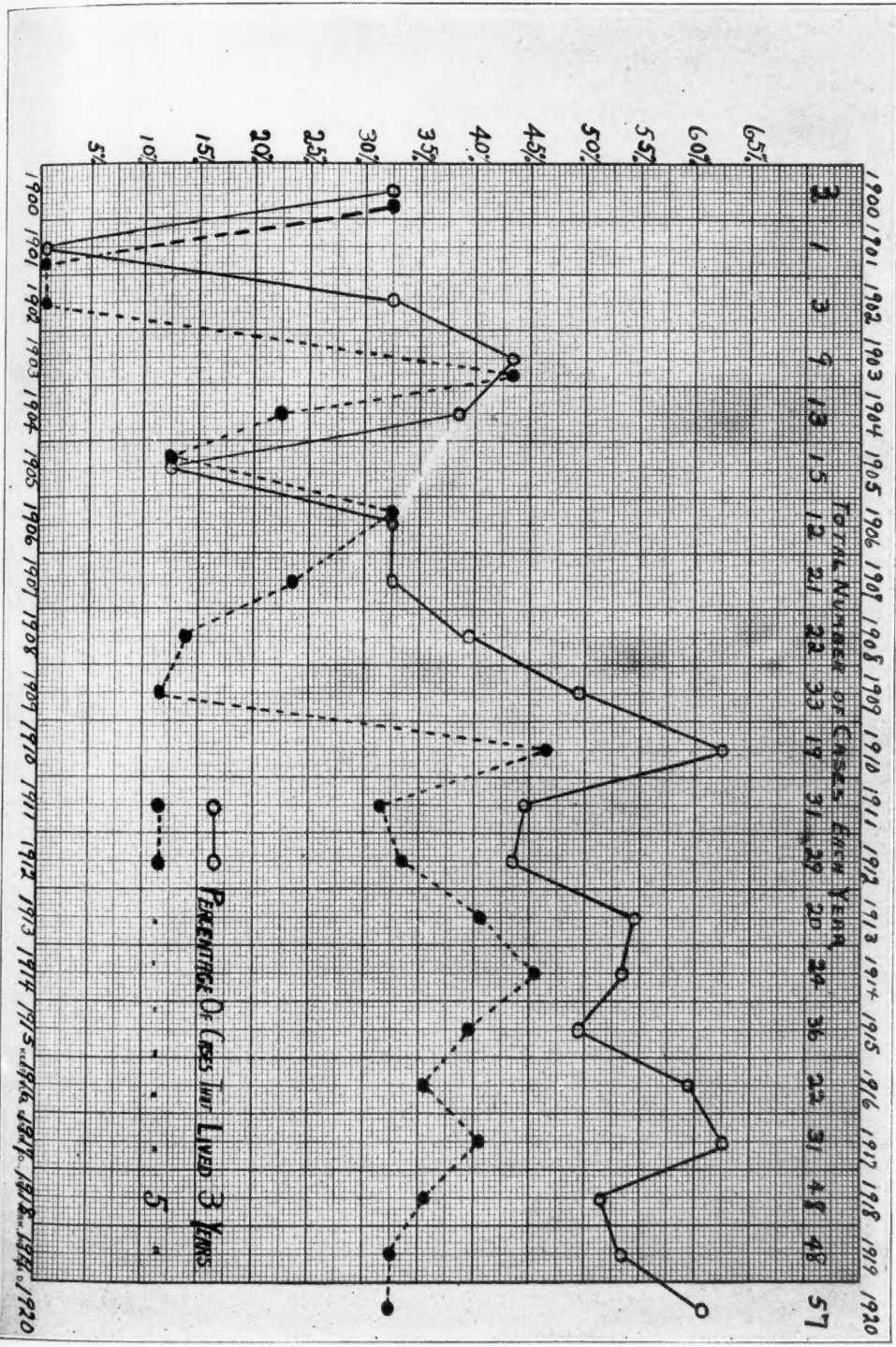
The end-results in carcinoma of the breast, as in carcinoma in any other location of the body, depend upon its early recognition and early treatment. It is only reasonable to suppose that the patient will have a longer duration of life if radiation treatment can be instituted early—at most, two to four weeks after operation. Recurrences are probably manifestations of a general dissemination. When glands are palpable, we must consider that there are probably many microscopic nests further on in the lymphatic chain. At this stage no form of treatment will always cure, any more than tetanus or diphtheria antitoxin will cure tetanus or diphtheria in their terminal stages.

TABLE V

ANALYSIS OF RADIATION VALUES ACCORDING
TO THE YEAR OF BEGINNING
TREATMENT

Year	No. cases	Alive 3 years	Per cent	Alive 5 years	Per cent
1900	3	1	33	1	33
1901	1	0	0	0	0
1902	3	1	33	0	0
1903	9	4	44	4	44
1904	13	5	38	3	23
1905	15	2	13	2	13
1906	12	4	33	4	33
1907	21	7	33	5	24
1908	22	9	40	3	14
1909	33	16	48	4	12
1910	19	12	63	9	47
1911	31	14	45	10	32
1912	29	13	44	10	34
1913	20	11	55	8	40
1914	24	13	54	11	45
1915	36	18	50	14	39
1916	22	13	59	8	36
1917	31	20	63	13	41
1918	48	25	52	17	35
1919	48	26	54	16	33
1920	57	35	61	19	33
1921	46	23	50		
1922	48	22	49		
Total	590	293	50	160	27

It will be seen, as suggested above, that here percentages do not represent the actual value of the varying technics. The percentage is influenced by the number of cases, but more particularly by the charac-



ter of cases referred. Take, for example, the years 1903—44 per cent, 1904—23 per cent, and 1905 only 13 per cent, alive at the end of five years. It is clearly evident that this reduction was not due to technic, for during this time there was very little change in technic. The great change began in 1905, with the introduction of Dr. Pfahler's filter technic, and from that time forward the rise occurred as is shown in Chart I. This chart shows that, while there are variations, the average curve is upwards, both at the 3-year and 5-year periods. The great fluctuations from year to year are shown in the years when the number of cases was small.

CONCLUSIONS

1. It is impossible to judge the value of a technic by statistics, unless the cases are most carefully classified according to the degree of malignancy and the extent of the disease.

2. The tables and chart show a general improvement in end-results, corresponding with the improvements in equipment and technic during the past twenty-five years.

3. With due consideration given to the degree of malignancy, and the extent of the disease, we are convinced, from our clinical observations, that the present technic with high voltage and highly filtered rays is giving better results than have ever been obtained before.

4. We have at hand now, however, so much power for good or evil that the keenest clinical judgment and the most expert technic are necessary, which must be adapted to the individual case in order to accomplish the greatest good and do no harm.

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DISCUSSION

DR. B. H. ORNDOFF (Chicago): I wish to discuss the paper of Dr. Pfahler and Dr. Widmann, Mr. Chairman, as I was unable to be here to hear the other papers of the Symposium.

Among the impressions that occurred to me when this splendid discussion of such a serious problem was presented by Dr. Widmann, was the angle from which carcinoma of the breast is viewed. I refer to the well established viewpoints of the surgeon and the internist, and now may be added the equally important viewpoint from the division of radiology. Surgical statistics covering a sufficient number of years have been recorded to give us a fair conception of what may be accomplished in this division of medicine. The medical treatment of cancer of the breast seems also to be a fairly finished problem. Radiotherapy, while not adding much in the way of a solution of the cancer problem, has materially improved statistics in the relief of cancer.

The technic of radiotherapy has changed considerably during the period from which the essayists have drawn the cases referred to in this paper. It is evident that some of the changes have been disappointing. I refer to the high voltage, homogeneous radiation and especially post-operative radiation. I would like to call attention to the inadvisability of intense radiation of an area after removal of a malignant mamma, where the tissues of the chest have been co-opted forcefully and are under constant tension, with subsequent vascular and lymphatic derangement. In such an area, radiotherapy seems to facilitate recurrence. At this point, co-operation between the surgeon and radiologist is essential. It is far more advisable in such cases to leave the wound open, avoiding all tension to skin flaps, and to institute radiotherapy into the open area as well as the axilla, subclavicular and other portals under a sane and conservative plan such as outlined in the technic of the essayists.

Referring again to the viewpoint of the radiologist, I am sure we are all impressed

with the problem that the localized tumor mass represents the disease in part only, *e. g.*, an epithelioma may disappear and a satisfactory scar remain without recurrence at its site. Almost always, however, the radiologist is impressed with the character of the skin in cases of epithelioma—the scaling, the fissures, the “heaping” tendencies which indicate that the localized tumor mass, which disappeared under radiotherapy, was but the local manifestation of the general tendencies in the individual skin. I may say we frequently see deep tumor masses disappear, but the malignant cachexia continues without interruption. The opposite condition is also observed by the radiologist. The systemic disease of malignancy may apparently be relieved by radiotherapy, yet the growth of the tumor mass may be only slightly relieved, or not affected at all. It would seem that no one has better opportunity to observe these phases of the disease than the radiologist.

The work of Burrows, Jorstad and Ernst, in the investigation of the relationship of the vitamin concentration and radiotherapy upon cell growth and malignancy, seems to be very important, and with these new additions to our knowledge of heredity, as demonstrated so conclusively by Dr. Slye at the University of Chicago, I feel confident that the basis for the scientific study of the eradication of the cancer disease has been established.

DR. WIDMANN (closing): We have set forth a detailed outline of our technic in the treatment of carcinoma of the breast. End-results will always be better in the earlier cases. We have shown that even in the late cases radiation therapy has been a great advance. There is still much room for improvement. There are many phases of this subject that would bear interesting discussion, but they are irrelevant to the issue of our subject. In the treatment of these cases, technical adjustments must always be considered in each individual case, so that experience and the clinical judgment of the radiologist are very important factors.

FIRST INFECTION IN PULMONARY TUBERCULOSIS¹

RADIOGRAPHIC EVIDENCE OF PLEURAL DISSEMINATION IN ADULT TYPE

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PROBABLY no other disease has received greater consideration and study than pulmonary tuberculosis. Much has been learned concerning its etiology and clinical symptoms. Great advances have been made in its treatment, yet in no other disease is so little definitely known concerning the initial location or method of infection.

There is no universal agreement as to the portal of entry in tuberculosis, and many even doubt the possibility of infection in adult life. The remarkable researches of Opie and Anderson (1, 2) have done much to establish the facts associated with first infections in tuberculosis. Their full significance is not yet entirely clear, nor is it improbable that some of the facts may remain, as yet, undiscovered. From their observations they have concluded that there are two types of tuberculous involvement, one predominating in infants and young children, the other being the most frequent type occurring in adults.

First infections in children are not prone to affect the apices more than any other portions of the lung. Such infections are always marked by involvement of the regional hilum glands. Caseation is prominent in children, but not in adults. Ghon (3) has shown that the hilum glands which drain the infected area may become caseous and attain greater size than the original focus, which has led to the erroneous opinion that the infection starts in the tracheobronchial nodes.

Apical lesions increase in frequency with the age of the individual; rarely are apical lesions found before ten years of age. In the adult, the tuberculous infection starts

in the apex. It either progresses by bronchial extension or heals with fibrosis; there is little tendency to involve the regional lymph nodes and caseation rarely occurs. It is possible, of course, for an individual to attain adult life without previous inoculation with tuberculosis in infancy. In this event, the infantile type of invasion will predominate in the adult lung, showing marked caseation of tracheobronchial nodes and a relatively small parenchymatous involvement; there will be little tendency to fibrosis or calcification. In other words, the apical lesions of adult tuberculosis, which tend to heal by fibrosis, cannot, in the light of this interpretation, be considered as first infections. They must represent secondary infections occurring in an individual previously infected during childhood, in which the primary lesion may have entirely disappeared or remain only as a small calcified deposit. Accepting this interpretation of the two types of tuberculous infection, the infantile being a first infection type, the adult (apical) type being a reinfection, the question which naturally presents itself is, Just what factors are concerned in producing these precise types of involvement?

Is it not possible that the adult apical type may also be a reinfection and that the explanation of the two general types may be found in some inherent difference in anatomical construction or physiological function in adults and children? Other pulmonary diseases vary, in mode of onset, course and tissue involvement, in adults and in children. Lobar pneumonia, for instance, when it occurs in adults, starts as a consolidation in the hilum region, rapidly spreading to involve an entire lobe, whereas in children the first consolidation noted is most frequently at the periphery, advancing

¹From the Departments of Radiology of the St. Louis City Hospitals and St. Mary's Hospital. Read before the Radiological Society of North America, at Cleveland, Dec., 1925.

inward toward the hilum. Often only a small segment of the lobe is involved at the onset and the spread is relatively slower than in the adult type of involvement. Perhaps here also the cause of this variation in the two types of involvement by the same disease, is due to some anatomical or physiological difference in the lungs of children and adults.

For a clearer understanding of the minute anatomy of the lung we are indebted to William Snow Miller (4). The divisions of the bronchial tree have been traced peripherally through their various stages: bronchus, bronchiole, respiratory bronchiole (being one into which atria open directly, assisting in respiration), atrium and terminal air sac.

It has been determined that the bronchial artery supplies the bronchus and its divisions peripherally as far as the respiratory bronchiole and that from here outward the pulmonary system supplies the minute structure of the lung; the blood from the bronchial and that from the pulmonary circulations mix and the minute capillaries form a network about the alveoli. Miller suggests that at the point of mixing of the two circulations there may be a retardation, offering conditions suitable for the initial tuberculous infection. The very mechanics of chest enlargement by elevation of the ribs produces less lung expansion in the apices than elsewhere in the lungs and would seem to make this a site of predilection for the lodgment and propagation of tuberculous disease.

The fact has been established that definite collections of lymphoid tissue are present at the bifurcation of the smaller divisions of the bronchioles, extending to the very periphery of the lung, and that lymph vessels accompany the bronchi and blood vessels, along their entire extent, anastomosing freely with each other and connecting with the lymphatics of the pleura. Lymph drains through these channels, from the region proximal to the respiratory bronchioles, toward the hilum; peripheral to the

respiratory bronchioles, lymph drainage is toward the pleura to the pleural lymphatics, parietal and interlobar, returning to the hilum by this route. Here, again, the region of transition of the lymphatic flow is

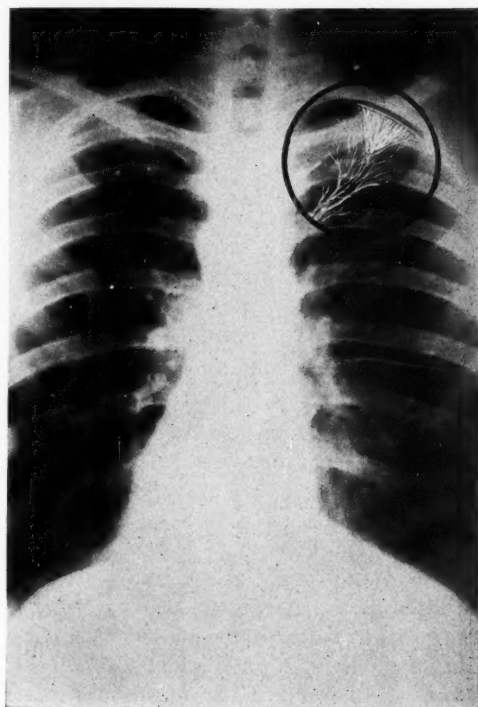


Fig. 1. Radiograph (retouched) showing earliest evidence of tuberculous lesion in lung. Note accentuation of the peribronchovascular markings extending toward hilum from lymph drainage in that direction (Dunham's fan). Note pleural thickening over area involved, due to drainage toward pleura. Note thickening of the interlobar pleura, shortest pleural route of infection to hilum.

the same region of sluggish blood circulation, a fact which may have significance.

Microscopically, the distance between the respiratory bronchiole and the pleural surface seems rather great, but in reality it is very short. If primary tuberculous involvement occurs at this site, then, for its detection in the radiograph we should examine the very periphery of the lung, just beneath the pleura. Since lymphatic drainage from this region is both toward the hilum and toward the periphery of the lung, we would expect engorgement of the lymphatic channels in both directions.

Those draining toward the hilum region converge as they extend inward, forming a "fan" described by Dunham (5). Those draining toward the pleura also show evidence of inflammatory reaction, by a thick-

upon the methods furnished by the existing knowledge and skill of the practitioner." The X-ray diagnosis of pulmonary tuberculosis is a purely anatomical diagnosis of lung involvement; if pleural thickening



Fig. 2. Enlarged radiograph (retouched) to show the character of the lesion as indicated in the involved area.

ening of the pleura. Pleural thickening is indicated by a dense line running along the chest wall at the very periphery, the thickening demonstrable only where the margin is viewed in profile. The reaction is most intense in the proximity of the lesion causing it, but close inspection will show evidences of thickening of the pleura over the shortest route to the hilum, over the interlobar pleura. Thickening of the interlobar pleura is present even where the parenchymatous lesion is confined to the apex. Thickening of the interlobar pleura then should always be looked for as a confirmatory radiographic sign in incipient pulmonary tuberculosis. Van Zwaluwenburg (6) demonstrated the presence of thickening of the apical pleura in a large percentage of otherwise normal individuals and concluded therefore that thickening of the apical pleura could not be considered as of pathologic significance. Opie says, however: "It is not possible, as many believe, to draw a line between clinical and latent tuberculous infection. The recognition depends

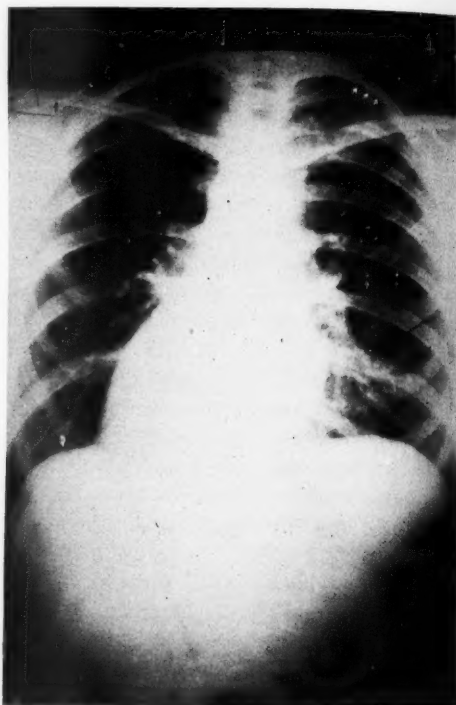


Fig. 3. Radiograph showing same conditions as in Figure 2. The lesion here represented is probably one of the earliest indications of tuberculous disease.

alone is present, unaccompanied by parenchymatous X-ray findings, it can be called nothing more than a thickened pleura, but if it be accompanied by parenchymatous findings in its vicinity it must be considered as a part of the pathological process. The presence of a thickened interlobar pleura is by no means characteristic of incipient pulmonary tuberculosis, any more than Dunham's fan is a specific indication of this disease. Fan formations occur in influenza and other subacute respiratory conditions and have been reported by Jarvis (7) in association with inhalation of rock dust, yet, eliminating these conditions from the individual case, fan formation may be

considered as a distinct aid in diagnosis of the very earliest lesion of tuberculosis. Similarly, thickening of the interlobar pleura is by no means characteristic of incipient pulmonary tuberculosis; it occurs in acute inflammatory infections, in chronic inhalation of irritating substances, and even in association with chronic congestive lesions of the lung, such as passive congestion from heart disease. Excluding recent inflammatory lesions and chronic heart disease, however, its occurrence in association with an apical lesion may be considered as strongly confirmatory of incipient pulmonary tuberculosis.

In an effort to determine the frequency with which the interlobar pleura was thickened in patients suffering from incipient tuberculous lesions, a study was made of 339 incipient cases occurring among 1,000 consecutive tuberculous cases. In anterior radiographs of the chest, made with ordinary technic without reference to demonstration of the interlobar area, thickening of the interlobar pleura was found in approximately two-thirds of the instances. Since the technic used was favorable only for showing the interlobar pleura between the middle and lower lobes on the right side, if only right-sided involvement were considered, a greater percentage of positive findings would have resulted with suitable technic.

I am sure that, with ordinary care and appropriate technic, thickening of the interlobar pleura can be demonstrated in a large majority of incipient tuberculous lesions. The pulmonary fissure dividing the upper from the lower lobe runs forward and downward from the level of about the fourth rib posteriorly to the sixth rib anteriorly. On the right side the middle lobe may be formed at the expense of either the upper or lower lobes, usually at the expense of the lower, the interlobar septum branching off from the septum separating the upper and lower lobes near the axillary line and proceeding downward with a greater ob-

liquity. To show a thickened interlobar pleura in the radiograph, the ray must be projected parallel to its surface. If examination of the chest is made with only the customary technic, centering about the fifth dorsal vertebra, then at best a thickening of the pleura between the upper and

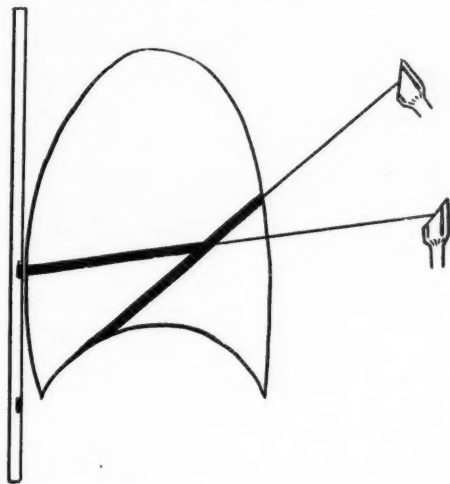


Fig. 4. Technic for demonstrating interlobar pleura. Ordinary technic centering at fifth dorsal with 36-inch tube distance gives proper inclination to show interlobar pleura between middle and upper lobes. Greater inclination of tube toward feet necessary to show interlobar pleura between middle and lower lobes.

middle lobes would show and any thickening between the middle and lower lobes would not show in the X-ray. On the left side, a definite pleural thickening could easily be missed.

For a demonstration of the interlobar pleura in this location a second exposure must be made, centering the tube high and tilting toward the feet.

SUMMARY

The facts established by Opie in connection with first infections in tuberculosis would seem to indicate two distinct types of pulmonary involvement: one, a first infection predominating in children, affecting all portions of the lung with equal frequency, always associated with regional caseous lymph nodes; the other, a re-infection

tion in adults, starting in the apex, tending to fibrosis and healing, never associated with caseous regional lymph nodes. The author feels that the adult type might also be considered as a first infection, the two different types of lesions being due to fundamental differences in anatomy and physiology between the adult's and child's lungs.

The adult type occurs at the periphery of the lung where the bronchial and pulmonary circulations mix. Lymph drainage from this region is in two directions: one, toward the hilum region, giving rise to the appearance of Dunham's fan; the other, toward the pleura, giving rise to thickening of the pleura in the region involved and in the interlobe. Thickening of the interlobar pleura on the involved side was found in a large majority of incipient cases. Thickening of the interlobar pleura is obviously not pathognomonic of incipient tuberculosis, but if the existence of other possible causes can be ruled out, it is of distinct significance when associated with questionable incipient lesions in the apex.

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DISCUSSION

DR. SANTE (closing): In reply to Dr. Bissell's remarks, I think that I could best quote Dr. Opie: "It is not possible, as many believe, to draw a line between clinical and latent tuberculous infection. The recognition depends upon the methods furnished and on the existing knowledge and skill of the practitioner." Dr. Opie, writing in reference to the distinction between clinically active and inactive tuberculosis, points out that it is not possible to distinguish between the two as pathological entities; in other words, I do not say that an apical gap is evidence of active tuberculosis, by any means; it is evidence of pathology in the pleura, and when it is accompanied by parenchymal changes under the pleura, we are justified from our previous experience in calling it incipient tuberculosis. I do not think we are justified in saying that it is active pulmonary tuberculosis, and I may say that all the slides shown to-day were taken of individuals who looked as healthy as you and I, and yet I feel that it is our business to make a diagnosis of incipient tuberculosis in all those cases, because our diagnosis is purely anatomical in nature. We get the same findings in cardiac insufficiency with pulmonary edema; we get the same thing in influenza; we get the same thing in many other conditions; we get the same thing in acute bronchitis, but barring all these, and barring dust inhalation and occupations of a character that would produce that, it merely serves to accentuate your opinion with reference to an apical lesion. It is one of the things that makes roentgenology a profession and not a trade. It is a matter of judgment and determination of the greatest degree of probability under the circumstances, and that is what I think constitutes diagnosis.

RADIO-ACTIVE SUBSTANCES AND THEIR THERAPEUTIC USES AND APPLICATIONS

RADIUM TREATMENT OF RECTAL CARCINOMA

(Concluded)

By JOSEPH MUIR, M.D., NEW YORK

THE problem which confronts the proctologist and the radiologist in their common struggle against rectal carcinoma appears to be the development of a technic which will make possible the application of relatively large dosage of radiation without danger of producing necrosis, with subsequent sloughing and systemic intoxication, and distortion of the tissues by cicatricial contraction. Though the reports from abroad are more encouraging than those given out in our country, it seems that up to the present no method which avoided all these difficulties has been proved of practical worth.

Yet it seems not unreasonable that adenocarcinoma, which is the type most often seen in the rectum, should be as amenable to radium treatment there as in other parts of the body, even though the mechanical disadvantages to be overcome are somewhat greater than in certain other areas. As we have seen, the extension of most of these rectal growths is below the surface, so that when seen through the proctoscope, but little idea of their actual dimensions can be obtained. In considering the application of radium to any neoplasm, accurate measurement is one of the chief factors of success, and it seems likely that much of the failure of this therapy in the past when applied to the rectum or sigmoid, may have been due to lack of appreciation of the size and stage of advancement presented by the lesion it was proposed to treat. We have seen, also, that rectal carcinoma is not especially rapid in its development, and early gives evidence of its presence—though, unfortunately, this evidence is, in the vast majority of instances, either misinterpreted or wholly disregarded. Metastasis also is relatively late, so that the radiologist—sum-

moned as he so often is at the eleventh hour—is offered greater opportunity of being able to reach the entire malignant area than is the case with similar growths elsewhere situated—upon the penis, or within the uterine cervix, for example. Successful radiation, then, will depend upon three factors: (1) Accurate estimation of the extent of the lesion, so that all parts of it may be adequately exposed to the therapeutic rays; (2) sufficiently high dosage to destroy all the proliferating malignant cells without inflicting injury upon adjacent healthy tissues; and finally, (3) the avoidance of all caustic action upon any of the tissues, so that there will be absolutely no danger of subsequent fistula formation, nor any of the dreaded sequelæ which in the past have so often attended the use of radium in the lower alimentary canal.

As with practically all other malignant lesions, the radiologist can hope for much better results if he is allowed to put forth his efforts when the growth is still in a comparatively early stage, but as his aid is so seldom sought until the condition is far-advanced, the reports of early rectal cancers subjected to radium treatment alone are so few as to be practically negligible. Yet, with the fulfilment of the requirements listed above, if the growth has not advanced so far as to have invaded the surrounding organs, and no secondary infection is as yet in evidence, the chances of cure, or of a marked degree of palliation, are still great enough to warrant the expenditure of the radiologist's best efforts.

When presented for radium treatment the lesion is in most cases an infiltrating ulcer upon the rectal wall, sometimes encircling the entire lumen of the bowel. Very often the request will be for post-operative treat-

ment only, the original lesion having been extirpated by resection of the gut, with anastomosis of the remaining healthy portion of the tube. In the majority of cases the condition will have progressed so far that complete obstruction will have taken place, making a previous colostomy imperative. The demand thus may be for direct application of radio-activity to the lesion, either through an artificial anus or through the natural opening with the aid of the proctoscope, or it may be for general radiation of the potentially malignant area remaining after the surgeon has endeavored to remove the focus of malignancy.

It is universally conceded that for the treatment of the deep adenomatous type of growth most common in the rectum, the direct implantation of the radio-active center is the most effective method. As has already been noted, considerable success has attended the attempts made at the Memorial Hospital to accomplish this by means of buried capillary tubes of radium emanation, the amount of necrosis following the use of these unscreened glass tubes being reduced as much as possible by making the amount of contained emanation in each individual tube very small—never more than two millicuries, and frequently no more than one-half a millicurie in strength. But so highly radiosensitive is the rectal mucosa that even these very small amounts have induced an undesirable necrosis, and the fact that the glass tubes—tiny though they are—have to be left in the tissue indefinitely, has the added disadvantage of the presence of retained foreign bodies.

The solution of this problem has been brought about by the introduction of a screened unit which can be removed when the desired period of exposure to radiation is concluded, but which at the same time retains all the advantages which attended the implantation of the bare tubes which preceded it. This removable platinum-radon seed is placed through the anus or the colostomy opening under the operator's direct vision, and, when the size of the le-

sion has been properly estimated, can be implanted with such accuracy as to insure even and complete radiation of all the malignant tissue. As soon as the desired amount of radiation has been applied, the seeds are withdrawn with but little inconvenience to either patient or operator—the one application and withdrawal being all that is necessary to effect adequate radiation.

The platinum filtration permits the use of much larger dosage than was possible under the old bare tube method, for it is now perfectly safe to employ as high a unit as two and a half millicuries decayed within the lesion, without danger of subsequent necrosis. A special implantation instrument has been devised for placing the deeper lying seeds, the needle of which is so gauged as to place them all at a uniform depth—usually from one to three centimeters below the surface. The seeds should be distributed evenly about the periphery of the growth, and as each one of these tiny containers of radium emanation is capable of inducing tissue change by throwing its therapeutic rays in all directions for a distance of one centimeter, it should be visualized as occupying when implanted, the center of a sphere of tissue with a radius of one centimeter. This entire "ball" is subjected to the effects of the gamma ray alone, the caustic beta radiation being eliminated by the seed's platinum filtration.

The number of seeds required and their exact position must be—as has already been noted—governed by the nature and extent of the lesion to be treated, but when compared with the old bare tube method, it can readily be appreciated that a much smaller number will be required to bring about like effects, and that the burden and annoyance to patient and operator alike will be proportionately lessened.

The removable feature of these seeds makes them especially applicable to a hollow organ such as the rectum or colon, where a retained foreign body of any sort is a distinct disadvantage, and this single point should do much to increase the effec-

tiveness of radium in the struggle to overcome this gravest of all rectal diseases.

The use of the removable platinum-radon seed has so many advantages over any other form of applying radium that every effort should be made to employ it, even when it can be used only through an artificial anus, though many patients think that in making use of radium treatment the colostomy can be avoided, so that they may require some persuasion before submitting to the previous surgical preparation.

The technic of placement is simplicity itself, but the operator must never lose sight of the fact that he has undertaken an intervention exactly as serious as one performed by surgical instruments, and every care in regard to asepsis must at all times be observed rigidly. Such precautions are of the greatest importance under any conditions, but when the lesion to be radiated is situated in the rectum, the necessity is, if possible, even more imperative.

A careful estimation of the size and shape of the lesion must be made before any decision as to the amount of radioactivity to be applied can be reached. In general, it may be stated that the seeds should be disposed at the three apices of an equilateral triangle, each side of this triangle having a length double that of the seed's radius of radiation. Thus, if the radiation radius be 1 cm., the length of the triangle's laterals should be 2 cm. It is immediately apparent how greatly the number of seeds needed for the implantation of a given amount of tissue has been reduced by the employment of the platinum-radon type. Three platinum-radon seeds, placed as just described, will provide adequate radiation for a lesion which would have required from thirty to forty of the bare tubes formerly used—and this, of course, takes no account of the after-effects of necrosis and prolonged sloughing, which are eliminated by the use of the platinum-filtered seeds. The disposal of the seeds will naturally vary with the character of the lesion—if, for example, we are presented with an ulcer raised upon an indurat-

ed base, the seeds must be disposed about the periphery, and the zone of potentially malignant though apparently healthy tissue which surrounds it, considered within the area to be covered by the radiation.

There is no form of cancer where improvement in treatment is so urgently needed as in that appearing in the lower bowel—the sigmoid and rectum. It should be impressed upon every physician that any bleeding or indefinite symptoms in this region, especially in patients of cancer age, ought to be regarded with great suspicion, and neither patient nor medical attendant should be contented with a diagnosis of "constipation" or "hemorrhoids" which is not promptly verified beyond all shadow of doubt. The poor results following surgery of rectal cancer are due in large measure to exactly the same factors as have prevented the success of radiotherapy—the advanced state of the lesions before they are presented for treatment of any kind. Yet, other things being equal, the suitability of such malignancies for radiation is certainly apparent, now that the dangers of subsequent necrosis can be positively eliminated, and it is to be hoped that within a short time we shall see a vast improvement in the present distressing mortality due to cancer of the rectum.

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Malignancy of nasal fossa and sinuses.—The author describes a method of resection of the supero-internal portion of the upper jaw in which the essential step is the removal of the ascending process and the neighboring supero-internal region of the body of the maxilla, as far out as the infra-orbital foramen. Portions of the nasal and ethmoid bones are resected to meet the requirements of the case. The incision begins at the supero-internal angle of the orbit and follows the margin of the nose till it ends below the nostril of the same side. A second incision passes horizontally outwards from this at the lower border of the orbit. The bone is then cut through along a line from the lower border of the pyriform fossa to the infra-orbital foramen and the whole of the ascending process removed. The aperture can be easily extended by removing the anterior surface of the maxilla or the floor of the frontal sinus, and it gives very liberal access to the nasal passages.

This method of approach is used chiefly in tumors of the nasal fossæ and the accessory sinuses. Malignant tumors are not often brought to notice in their early stages and are difficult of diagnosis. Usually by the time they are seen they have a wide area of attachment and a liberal supply of blood and lymphatic vessels. It is then often found that a tumor presenting in the nasal fossa has invaded various ones of the sinuses, chiefly the frontal and sphenoidal, and may have penetrated the orbit or the nasopharynx. The ethmoid is much less often involved secondarily than primarily, tumor formation usually starting in it and extending into the sinuses.

Opacity to transillumination or to X-rays in the accessory sinuses does not always indicate malignant extension, but is often a sign of purulent sinusitis only.

The author's method is applicable to malignant tumors arising in the nasal fossæ, accessory sinuses, or in the nasopharynx. Tumors limited to the anterior portion of the septum or the floor of the nasal fossa can be treated by a much less radical operation. For tumor of the alveolar margin of the maxilla only the lower part of the maxilla is removed and any extension of disease can then be followed up. Except when dealing with a generalized osteosarcoma of the upper maxilla the author does not employ the classical operation of excision of the bone, but performs the operation described. Moore, Liébault, and Canuyt have described a somewhat similar operation in which a vertical cut is made in the nasal bone, close to the septum; a horizontal cut is made outwards from the anterior naris in the anterior surface of the maxilla; this latter is joined to the orbital margin by a vertical cut immediately internal to the infra-orbital foramen. The cut in the nasal bone is joined to the orbit by a horizontal incision and the large surface of bone thus freed is separated from its attachment to the floor of the orbit and removed.

Partial Resection of the Upper Jaw in Malignant Disease of the Nasal Fossa and Sinuses. S. Citelli. *Arch. Ital. di Otol. e Laringol.*, Dec., 1925, p. 795. (Reprinted by permission from *Brit. Med. Jour.*, March 20, 1926, p. 51 of *Epitome of Current Medical Literature.*)

ONE HUNDRED MILLIAMPERE, ONE-TENTH OF A SECOND TECHNIC

By E. C. JERMAN, CHICAGO

Part	Position	Kilovolts Peak	Pre-reading Volts	Milli-amperes	Distance	Time	Tube
Chest	P.A.	78		100	40 in.	1/10	5-100
Heart	P.A.	95		100	6 ft.	1/10	5-100
Infants		78		100	36 in.	1/10	5-100
Extremities		75		100	36 in.	1/10	5-100

The above chart is based upon an average adult (150 pounds), except as in the case of infants, as noted. A 5-30 radiator tube, fine or medium focus universal, may be used, if the 5-100 tube is not available. To change radiographic density vary auto-transformer (pre-reading volts).

CHEST TECHNIC

There probably is no region of the body over which so much controversy and diversity of opinion exists as the chest. Distance varies from 28 inches to nine feet. Time of exposure varies from one-twentieth second to as high as four seconds. Milliamperage varies from 5 ma. to 350 ma., some experimental work having been done with as high as 1,000 ma. The kilovolts peak varies from 50 K.V.P. to 130 K.V.P. According to the experience of the writer, the distance more commonly used varies from three to four feet; the milliamperage from 30 ma. to 100 ma.; the time of exposure from 1/10 to 1/2 second; the K.V.P. from 60 K.V.P. to 100 K.V.P. There is also some difference of opinion among roentgenologists regarding the use of intensifying screens, a few preferring not to use them. However, the great majority prefer to use them.

There are several reasons for this diversity of opinion, one being the wide variation in equipment: the factors have to be adjusted to conform with the particular type of equipment used. Another reason is the fact that there has been no commonly accepted standard of radiographic density. It is possible that all roentgenologists are

not looking for exactly the same type of lung structure. Marked progress has been made during the past year towards the improvement of this situation. There is considerable tendency towards the use of shorter exposure time with high milliamperage.

Equipment.—A transformer of sufficient capacity, with a control of sufficiently uniform regulation to handle the amount of energy required.

Double intensifying screens are ordinarily used for this work, as the large amount of energy required would make such work impractical without them. The use of screens also provides additional contrast.

A time switch of tested accuracy must be used in order that the exposure time may be consistently duplicated. The time switch should be checked with the spinning top method, using the energy ordinarily used for chest work.

A Bucky diaphragm is not used for chest work, although there are some possibilities in this direction.

A stabilizer is practically a necessity in order to obviate the necessity of tube testing, and to keep the milliamperage factor constant regardless of the K.V.P. used.

The 5-30 radiator type tube may be used on the 1/10 second basis only, providing a stabilizer is used. The 5-100 radiator type tube is, of course, the ideal tube for such work. A medium focus universal tube also may be used, but this necessitates a sacrifice in detail.

Technic.—A distance of 40 inches has been selected in the above table, because it has become quite commonly accepted by

radiologists. With this distance a wealth of detail is obtainable when the smaller focal spots are used, without great danger to the tube.

One hundred milliamperes have been selected in order that more contrast may be obtained with the use of lower voltage with shorter exposure time.

An exposure time of 1/10 second has been selected in order that movement due to respiration and heart action may be largely eliminated.

With the above factors fixed, the radiographic density is controlled by varying the K.V.P. with the autotransformer.

The K.V.P. varies from 70 K.V.P. to 85 K.V.P., depending upon the thickness and density of the region exposed.

Position of Patient, Tube and Cassette.—The position of the patient is usually standing, P.A., with the chest resting against the cassette, elbows flexed, with the back of the hands resting on the hips, elbows and shoulders forward, and chin elevated. The cassette should be so placed that approximately 11½ inches of the film above the shoulders receives direct exposure. The tube is then centered to the center, or slightly above the center, of the cassette.

HEART TECHNIC

In heart technic it is necessary only to obtain a sharp outline of the heart shadow at as nearly as possible normal size. There may be permissible a considerable variation in radiographic density.

Equipment.—The same equipment factors required for chest work are required for heart work, with the exception of the tube. The medium or broad focus universal type tubes are ordinarily used for this work, preferably the medium.

Technic.—A distance of six feet is advised in order that the image on the film may approximate the actual size of the heart.

One hundred milliamperes are advised in order that greater contrast may be obtained with the shorter exposure time.

An exposure time of 1/10 second is advised in order that danger of movement due to heart action may be reduced.

With the above factors fixed, the radiographic density is controlled by varying the K.V.P. with the autotransformer, the K.V.P. varying from 95 to 110 K.V.P., depending upon the density and thickness of the region exposed.

Position of Patient, Tube and Cassette.—The position of the patient is usually standing, P.A., with the chest resting against the cassette, the tube centered to the center of the cassette.

INFANTS

The principal difficulty in radiographing infants is the danger of movement of the patient.

Equipment.—The same equipment factors required for chest work are required for this work.

Technic.—A distance of 36 inches has been selected, in the above table, as this distance represents the average maximum distance obtainable with most tables.

One hundred milliamperes have been selected in order that more contrast may be obtained with the use of lower voltage, with a shorter exposure time.

An exposure time of 1/10 second is advised in order that danger of movement may be lessened.

With the above factors fixed, the radiographic density is controlled by varying the K.V.P. with the autotransformer, the K.V.P. varying from 65 K.V.P. to 80 K.V.P., depending on the thickness and density of the region exposed.

Position of Patient, Tube and Cassette.—The patient is placed upon the cassette, with the tube centered to center of cassette.

EXTREMITIES

Extremity work is ordinarily done with the longer exposure time. This technic is

suggested for that class of work for which a very short time must be used due to the condition of the patient.

Equipment.—The same equipment factors required for chest work are required for this work.

Technic.—The same technic factors used for infants are used for this work, except

the K.V.P. range. The range of K.V.P. for this work is from 50 to 85 K.V.P., depending on the thickness and density of the region exposed.

Position of Patient, Tube and Cassette.—The part to be radiographed is placed in the desired position on the cassette, with the tube centered to the center of the cassette.

Epigastric distress.—The author discusses in detail the etiology and treatment of gastric discomfort and pain, with or without acidity. He finds that gastric distress is more common in the anxious and energetic type of patient, the usual cause being spasm of the stomach excited by air imprisoned by spasm of the esophagus and pylorus. He does not think that high gastric acidity is the primary cause, and attributes the discomfort to irritability of the gastric nerves, or rather to their centers in the spinal cord. The production of acidity is due to vagal stimulation, and the acidity frequently excites the spinal centers and induces gastric spasm. This can be promptly relieved by such antacids as sodium bicarbonate and magnesia.

Some cases are due to chronic focal disease within the abdomen, especially of the gall bladder, appendix, stomach, and duodenum, which increases the irritability of the spinal and pneumogastric centers. A searching examination should therefore always be made of these organs, and X-rays assist in doubtful cases.

Other causes may be eye-strain, or disease of the ear, teeth, or tonsils, the pain being referred

to the stomach through the vagal and spinal centers. Cardiac symptoms, such as irregularity of beat and premature ventricular systoles, may occur, and increased salivary secretion is frequent.

Stress is laid on dealing with functional causes in obtaining permanent cure. W. Verdon has suggested that esophageal gastric spasm may sometimes be the exciting cause of angina pectoris; the present author agrees with this, and believes also that angina pectoris may be the cause of the latter condition. Treatment includes the administration of 15 grains of sodium bicarbonate, or more, in half a pint of water, one hour before each meal, to lessen acidity and flush out the stomach contents. A mild laxative is usually required, and attention should be paid to the diet. Strontium bromide and tincture of belladonna have also been found useful.

Epigastric Distress: Functional Causes and Treatment. Alexander McPhedran. *Canadian Med. Assn. Jour.*, Feb., 1926, p. 121. (Reprinted by permission from *Brit. Med. Jour.*, March 20, 1926, p. 51 of *Epitome of Current Medical Literature.*)

CASE REPORTS

ROENTGEN TREATMENT OF PULMONARY INFILTRATION INDUCED BY MASSIVE RADIATION OF THE CHEST: REPORT OF A CASE¹

By JACOB ROEMER, M.D., PATERSON, N. J.

It is a well known fact that if massive doses of roentgen rays are applied to the chest, certain pathologic changes may occur in the pleura and lungs, such changes manifesting themselves sometimes in slight infiltrations and at other times the condition becoming so far advanced as to involve one or more lobes of the lungs. Reports of many such cases are found in the literature, particularly within the last few years, since the advent of the so-called deep therapy.

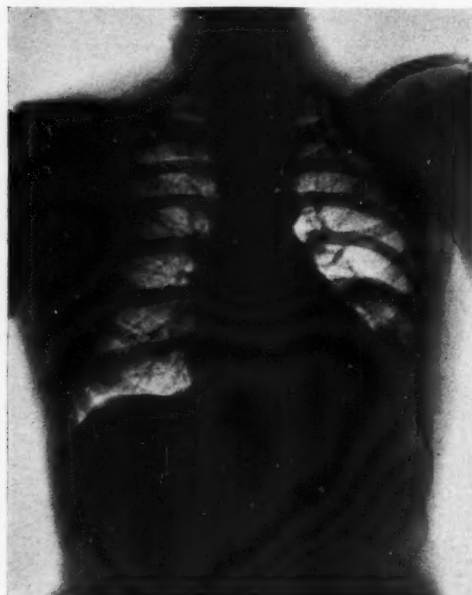


Fig. 1.

In this paper we are mainly concerned with the pulmonary infiltration which is the most common and most dangerous complication. Roentgenologically this condition

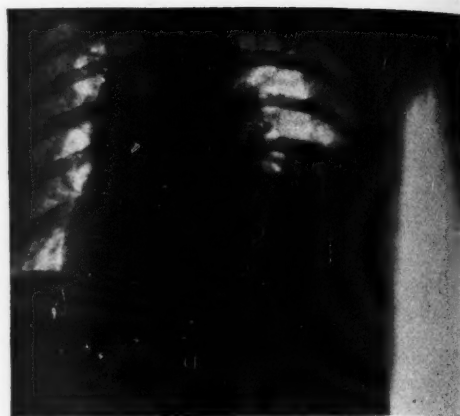


Fig. 2.

resembles pneumonia, from which it is clinically easily differentiated. It is, however, difficult to differentiate it from pulmonary metastasis. These pulmonary changes are generally induced by irradiating the chest for carcinoma of the breast or pulmonary neoplasm. Such reaction may set in from one to six months after the radiation, and, when it resolves, it leaves fibrosis. It takes from three to nine months for the resolution to take place. Patients so affected are susceptible to pulmonary infection, and, if pneumonia is contracted under such conditions, it is usually fatal. Once such reaction takes place, it is a contra-indication to further radiation, as the injured tissue presents a *locus minoris resistentiae*. In this connection I wish to report a case which may have some significance as to the treatment of the above-mentioned pulmonary complication.

On September 14, 1923, Miss J. S., aged 42, was referred for pre-operative treatment for carcinoma of the left breast. The general condition was fair, and on that day she was given an erythema dose to the breast with a radiation of the following conditions: 215 K.V., 0.75 mm. Cu. and 1 mm. Al., 10×10 field, 50 cm. F.S.D. (This erythema dose corresponds to 1,300 R-units

¹ Received for publication in December, 1925.

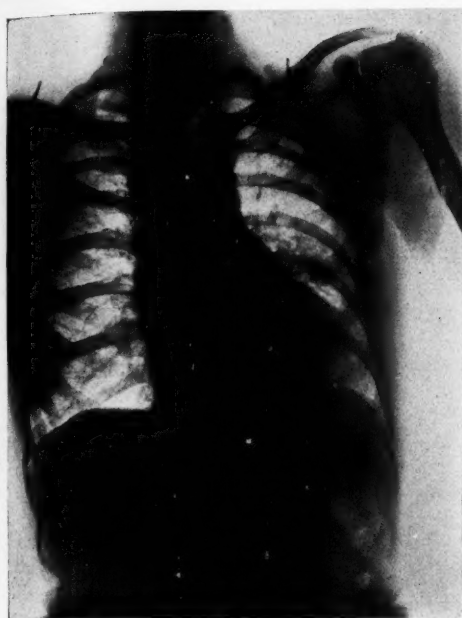


Fig. 3.



Fig. 4.

as measured by Glasser.) On September 17 the patient received a like dose to the left axilla and on September 25 a similar dose was given to the supraclavicular region. About two weeks after the last treatment a radical operation was performed by Dr. T. A. Dingman. The patient made an uneventful recovery and on November 21 the second series of massive deep therapy was begun. On this day the patient received a full erythema dose, under the conditions stated above, to the left breast area and to the axilla; at this time the portal of entry was 20×20 cm. On December 13 the patient received one-half of an erythema dose, field 10×10 cm., to the left supraclavicular region and on the fifteenth of the same month, another half of an erythema dose to the same region.

About four months after the second course of treatments the patient began to complain of pain on the left side of the chest, dyspnea and a dry cough, which condition became progressively worse. On May 10 the operating surgeon referred the

patient back to me, suspecting that she suffered from pulmonary metastasis. The physical examination revealed a consolidation at the base of the left lung, over which area there were bronchial breathing and numerous fine and coarse râles. Radiographic examination showed a dense shadow at the left base, obliterating the left cardiophrenic and costophrenic angles (Fig. 1).

On May 24 another radiographic examination was made and at this time the infiltration at the left base was more pronounced, involving also the mediastinum (Fig. 2). From the radiographic examination and the clinical history it appeared that we were not dealing with a pulmonary metastasis: I felt reasonably sure that we had a pulmonary infiltration secondary to radiation therapy.

On the basis that small doses of roentgen ray have been recommended in the treatment of post-operative pneumonia and in delayed resolution, I decided to try fractional X-ray doses. This was done in four séances at three-day intervals, starting May

24, as follows: 215 K.V., 0.75 mm. Cu. and 1 mm. Al., 15×15 cm. field, 50 cm. F.S.D. The chest was radiated through three portals of entry—front, back and lateral. The total depth dose amounted to about 40 per cent. After the first two treatments the patient felt slightly improved and, much to my surprise when examining her on June 13, 1924, the condition had practically cleared up (Fig. 3). July 15, 1924, the patient was again examined and at this time she was in perfectly good health and the chest condition had entirely cleared up (Fig. 4). At the time of writing the patient is still enjoying perfect health.

The fact that this condition cleared up on so small a dose is quite conclusive evidence that we were not dealing with metastasis to the lungs, as such would require massive radiation and, at best, it would take a much longer time to show any improvement. We may therefore conclude that we were dealing with a benign condition, as mentioned above, and that the stimulating effect of the roentgen rays caused a resolution *ad integrum*.

The value of a therapeutic measure based on one case may not appear conclusive, although this was the only case of a definite lung injury induced by heavy radiation that the writer has had in his experience. The result was so striking that he feels justified in presenting it, in the hope that others may give the method further trial.

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REPORT OF A CASE OF GASTRIC DIVERTICULUM

By JOHN D. LAWSON, M.D., Department of Radiology, Woodland Clinic, WOODLAND, CALIFORNIA

Gastric diverticula are of such infrequent occurrence that I believe single case reports are warranted. A very excellent article has recently been added to the literature on this subject by Gray,¹ who has summarized the previous reports. In view of his work, no such summary is made here.

Miss I. F., age 50, was first seen at the clinic on June 22, 1925, complaining of gas, sour stomach and colicky pains in the upper right quadrant of the abdomen, with occasional radiation of pain to the right scapula. This syndrome first appeared ten years before our observation of the patient, and lasted several months. Following this first attack, she had no abdominal or gastric disturbance until June, 1924, when the same symptoms returned and persisted up to the time of observation.

Physical examination was negative except for infected tonsils and teeth. The urinalysis and blood count were not remarkable and the blood Wassermann was negative. Roentgen examination of the gastrointestinal tract was made and the following report given:²

"Radio-opaque meal of 750 c.c. barium mixture. Esophagus transmits food normally, no cardiospasm. Stomach fills normally, J-type, mobility normal, motility normal, tonus good. There is a definite extravasation of the barium mixture beyond the gastric border on the posterior surface at about the level of the esophageal opening. The size of the pouch is approximately 2×3 cm. There is regurgitation of the meal into the esophagus. Duodenal bulb fills normally; shows no deformity, irregularity, or angulation. Six-hour examination shows

¹Gray, Diverticulum of stomach. *Am. Jour. Roentgenol. and Rad. Ther.*, August, 1925, p. 110.

²This patient was independently examined by Dr. John R. O'Neil of San Francisco, whose findings and conclusion were the same.



Fig. 1. Radiograph of opaque meal immediately after ingestion. (See diagram, Fig. 3.)



Fig. 2. Six hours after ingestion of barium. Arrow indicates diverticulum filled with barium.

the stomach empty. The pouch noted above is still filled. Twenty-four-hour examination shows normal colon findings. Several gall-bladder films show a rounded contour in the gall-bladder area. Roentgen conclusions: (1) Cholecystitis, chronic; (2) The outpouching from the stomach may be a perforating gastric ulcer or a diverticulum of the stomach. The even contour of the pouch would make the latter diagnosis more probable even though the percentage of occurrence is extremely small."

The patient was operated upon on June 29, 1925, and the surgeons made the following report:

"Pre-operative diagnosis: (1) Cholecystitis, chronic, with stones; (2) Appendicitis, chronic; (3) Gastric ulcer.

"Operation: Under ether anesthesia a high midline incision was made. The gall bladder was found to contain numerous stones and to be sub-acutely inflamed. Cholecystectomy was done. The appendix was kinked doubly upon itself, had many adhe-

sions about it and was sub-acutely inflamed. Appendectomy was done. There were filmy adhesions of the omentum to the entire lower pelvis. These were broken easily. The uterus was atrophic, the tubes and ovaries normal. The duodenum was normal. The stomach was pulled down easily and no masses or inflammatory processes were found in the stomach from the esophageal opening down to the duodenum. The gastro-colic omentum was opened and a hand slipped behind the stomach and careful examination was again made of the whole of the stomach. This was negative as far as we were able to demonstrate. We feel that the X-ray retention of barium was probably due to a diverticulum of the stomach or of the esophagus.

"Post-operative diagnosis: (1) Cholecystitis, sub-acute, with stones; (2) Appendicitis, sub-acute; (3) Possible diverticulum of stomach or esophagus."

The patient's convalescence was uneventful. She returned to us on October 20,

1925, for observation. Roentgen re-examination of the gastro-intestinal tract showed the same gastric lesion as was noted in June, 1925.

DISCUSSION

The fact that the lesion was not observed at operation does not invalidate the diagnosis, as both of the surgeons agree that a

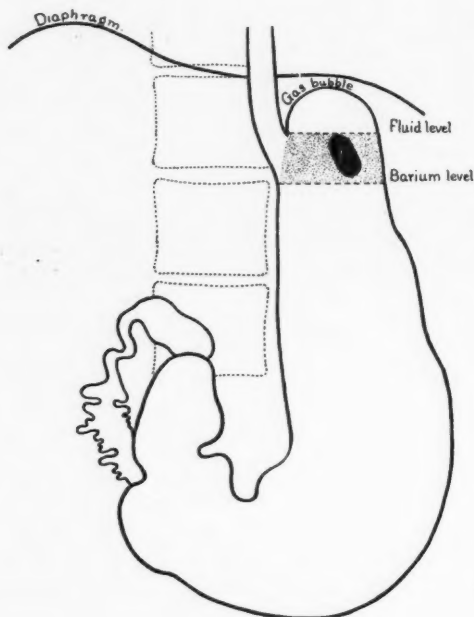


Fig. 3.

lesion of this size could easily be overlooked. In this case a very careful search was made, but an outpouching of 2 cm. in diameter would be very difficult to palpate unless there were present at the same time adhesions or other evidence of inflammation.

We feel that, at no time, have the patient's symptoms been referable to the diverticulum, and the absence of adhesions or any local signs of disease substantiates this opinion. The entire symptomatology could be explained on a basis of cholecystitis, with stones.

POLYPOID TUMORS IN THE PYLORIC END OF THE STOMACH: REPORTS OF THREE CASES¹

By CHARLES G. SUTHERLAND, M.B. (Tor.),
Section on Roentgenology, Mayo Clinic,
ROCHESTER, MINNESOTA

Case I.—A woman, aged sixty, came to the clinic complaining of "stomach trouble" of one year's duration. She had been in excellent health and able to eat anything until one year before, when she had a sudden attack of severe pain in the left upper quadrant, radiating to the epigastrium, with nausea and vomiting. The attack lasted about five minutes; there was no residual soreness, but the patient became "yellow" half a day later, the discoloration lasting three days. Since that time she has had intermittent attacks of nausea about one hour after eating, relieved at once by vomiting or by soda, hunger pain relieved by food, belching, and sour eructations. One month before coming here she experienced a second attack, similar to the first but not so severe. At this time she consulted a physician, who found pus in the urine.

Examination at the clinic revealed a movable tender mass in the right flank supposed to be a kidney. A roentgenogram revealed a large shadow in the area of the right kidney at the level of the fourth lumbar vertebra, and cystoscopic examination showed the function of the right kidney to be greatly impaired. Roentgenoscopy elicited a narrowing of the antrum of the stomach, the prepyloric spasm so frequently associated with gastric ulcer, and the films presented a saucer-shaped defect in the duodenal cap. This was reported as a lesion of the pyloric end of the stomach.

At operation, a soft movable tumor, about 6 cm. in diameter, was found at the pyloric end of the stomach; this tumor could be invaginated into the duodenum. The patient also had a gastric ulcer on the lesser curvature, about 7.5 cm. above the pylorus. Because of the double lesion

¹ Received for publication October 28, 1925.



Fig. 1. Note the spastic narrowing of the pylorus frequently associated with ulcer on the lesser curvature. There is a cup-shaped deformity of the base of the duodenal cap. At operation a gastric ulcer was found with an area of polypoid mucosa extending into, but not involving, the duodenum.



Fig. 2. Roentgenoscopically this defect in the pylorus was smooth-margined; no shelf was elicited and there was no palpable mass. The diagnosis was "inflammatory obstructive lesion, possibly luetic." Surgical investigation proved this to be a polyposis associated with multiple ulcerations just above the pylorus.

about one-third of the stomach was resected (posterior Polya). The pathologic report was subacute gastric ulcer (9 mm. in diameter) and an area of polypoid mucosa near the pylorus, extending into, but not involving, the duodenum.

The patient had an uneventful convalescence and was operated on again twenty days later, when a right pyonephrosis with one stone, 3 by 2.5 cm., and some sandy material was found. The kidney was resected, and pathologic examination showed that 80 per cent of the renal substance was destroyed. The patient was dismissed fifteen days after the second operation (Fig. 1).

Comment.—The possibility of the invagination of the tumor into the duodenum explains the two severe attacks which the patient experienced, with temporary jaundice, at wide intervals. The tumor probably exerted a ball-valve action on the py-

loric ring and was doubtless impacted at the times marked by these two attacks.

Case 2.—A man, aged fifty-one, came to the clinic in February, 1925, complaining of anemia, and weakness in the legs. In 1920, a stool examination made here showed *Entamoeba histolytica*; under emetin iodid treatment his condition had been markedly improved, but the patient suffered several recurrences and in 1923 developed glossitis, which commenced without swelling or discomfort other than tenderness of the tongue when drinking hot liquids. A marked anemia had persisted throughout his illness.

The hemoglobin varied between 66 and 70 per cent, and the erythrocytes between 3,870,000 and 3,020,000 at different periods. There was nothing of significance in two differential counts made. Gastric analysis showed persistent achylia, and the condition was considered to be possibly



Fig. 3. Adenomyomatous polyp arising from the stomach, just at the pylorus, and invaginated into the duodenum. The tumor occluded the greater portion of the barium but left the contour of the duodenum intact. This was diagnosed as a benign tumor.

preliminary to pernicious anemia. Roentgenoscopic examination of the stomach in February, 1925, elicited an obstructive lesion in the pyloric end of the stomach. The possibility of syphilis was suggested but the reaction to the Wassermann blood test was negative. Clinically the possibility of carcinoma of the stomach was considered, and surgical investigation advised. At operation polyposis was found, associated with multiple ulcerations in the pylorus just above the pyloric ring. The pylorus, including the polyps and the ulcerated area, was resected, and pathologic study proved the condition to be an early polyposis associated with a localized gastritis. Convalescence was uneventful and a reply to a recent questionnaire reported some general improvement in the patient's condition (Fig. 2).

Case 3. — A man, aged sixty-one, was admitted complaining of anemia which had



Fig. 4. Gross specimen of tumor (Fig. 3). The tumor was multilobulated and the floating of the barium between the lobules gives the trabeculated appearance seen in the roentgenogram.

lasted three years. During this time the color of his skin had become yellowish. He had experienced slight dyspnea at times on exertion and slight vertigo on stooping, but no headache. Two years before, he had suffered intermittent attacks of diarrhea for two months, and since then had been constipated. Six months before, there was some epigastric discomfort one-half hour after eating, but never any nausea or vomiting. There was no history of any acute abdominal attack.

Physical examination elicited nothing of interest; the hemoglobin was 38 per cent and erythrocytes numbered 3,270,000; the differential count showed nothing abnormal. One fractional test-meal gave evidence of achylia. Roentgenoscopy revealed an interesting filling defect in the duodenum; the barium was occluded by a tumor and presented a screen picture of fine trabeculations running in various directions across the cap (Fig. 3). A diagnosis of benign tumor was made. At operation a movable tumor was found attached in the stomach close to the pylorus. The mass could be expressed from the duodenum into

the stomach. It was excised, and pathologic examination proved it to be a multilobular adenomyomatous polyp, 4 cm. in diameter. It is remarkable that this patient had no history of obstruction or impaction; in fact, there was little in his history to suggest the gastric intestinal lesion which was found in the gastro-intestinal study carried out as a routine in cases of anemia (Fig. 4).

PERIOSTEAL CHANGES IN A CASE OF LYMPHATIC LEUKEMIA¹

By HENRY K. TAYLOR, M.D., NEW YORK CITY

The radiographic findings in this case being rather unusual and uncommon and a review of the literature within the past few

years failing to disclose any other cases with similar radiographic changes, a report of this case is warranted.

V. R., age two years and ten months, was admitted to the hospital September 25, 1925, for progressive weakness and inability to walk. The family and past history were essentially negative. There was no abnormality as regards birth and feeding. There was no history of any previous illness, and physical and mental development up to the time of admission were normal. The present illness dated back to seven months before admission to the hospital (February, 1925), when the child began to complain of an inability to walk. On the following day the mother noticed that both

¹From the X-ray Department, Beth Israel Hospital, New York City.



Fig. 1. Elevation of periosteum of humerus, radius, ulna and metacarpals due to lymphatic infiltration.



Fig. 2. Elevation of periosteum of femora due to lymphatic infiltration.



Fig. 3. Elevation of periosteum of tibiae and fibulae due to lymphatic infiltration.

legs were swollen. The next day the upper extremities, from the elbows down, were swollen. The swelling was hot and tender, but there was no evidence of any redness. The child, however, did not run any temperature. Two months after the onset of the present illness the mother noticed that she had developed a morbid pallor. She had lost twenty pounds in the seven months from the onset of her present symptoms to the time of admission to the hospital.

Physical examination revealed a child who looked chronically ill and apathetic. The face and mucous membranes were pale, and the eyes puffy. The submaxillary and inguinal nodes were definitely enlarged, while the axillary and epitrochlear showed no evidence of enlargement. The tonsils were hypertrophied but not diseased. The spleen was enlarged to about two inches below the costal margin. The child was able to move her extremities voluntarily but cried when they were manipulated by the examiner.

Repeated blood counts showed a red cell count varying from 1,200,000 to 3,800,000, with a hemoglobin ranging from 20 to 75 per cent. The white cell count varied from 1,900 to 147,000, with four aleukemic periods during two months, the small mononuclear lymphocyte predominating at all times. Abnormal cells noted were nucleated reds, macrocytes, myelocytes, lymphoblasts, normoblasts and myeloblasts. Anisocytosis and poikilocytosis were also noted. The Wassermann reaction was negative.

The temperature during the stay at the hospital was always above normal and at times reached 104 degrees. Ecchymoses developed at various times and in different parts of the body, and on one occasion the child had a bloody bowel movement.

The roentgen findings of all the long bones, including the metacarpals and metatarsals (Figs. 1, 2 and 3), showed a slight elevation of the periosteum, with some productive changes. There was no evidence

present either clinically or radiographically, to suggest rickets, scurvy or syphilis.

The child died November 30, 1925, and autopsy revealed the following: External examination of the body showed a marked general anemia. There was a moderate en-

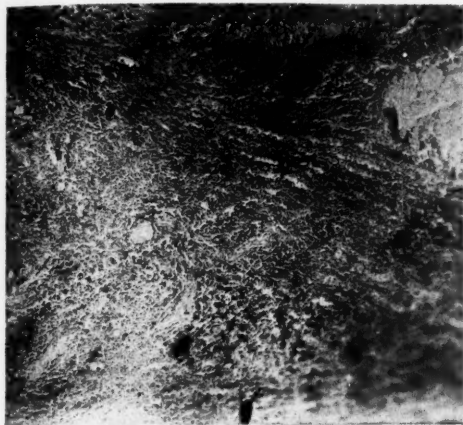


Fig. 4. Cross-section of periosteum from right tibia showing lymphatic infiltration. (Low power.)

largement and a diffuse pigmentation of the spleen, with a complete absence of the malpighian follicles. The liver was comparatively small, diffusely pigmented, with a fine plexiform infiltration in the periportal connective tissues. There was a moderate hyperplasia of the lymph nodes, with a striking hyperemia of the lymphatic tissues. The lungs showed a disseminated bronchopneumonia. Microscopic examination revealed a lymphatic infiltration of the spleen and lymph nodes, the latter showing a marked congestion. There was very little infiltration of the liver between the liver cells, the infiltration being more marked in the periportal tissues. A section taken from the right tibia showed a lymphatic infiltration underneath the periosteum, and replacement of the bone marrow. A summation of the postmortem findings thus verified the diagnosis of a chronic lymphatic leukemia.

SUB-PLEURAL FIBROLIPOMA: REPORT OF CASE

By GEORGE H. HESS, M.D., UNIONTOWN, PA.

Patient, Miss G., aged forty-nine, white, weighing about ninety pounds, employed as a matron at city comfort station. Referred by Dr. J. G. Hemington for X-ray examination of chest, July 3, 1924. Chief complaint: Shortness of breath upon slight exertion or when in a crowd. First noticed this condition persisting following an attack of influenza and congestion of lungs in January, 1921. Had pleurisy of left side in March, 1924, and was sick about ten days. Had pleurisy of left side again in June, 1924, and was in bed this time about a week.

There has been no loss of weight. Appetite always poor, tires very easily. No history of tuberculosis or malignancy in the family. Blood Wassermann negative. Patient was poorly nourished, of a sallow, muddy complexion, and slow in speech and movement.

Roentgen-ray findings July 3, 1924: Dense, sharply outlined spherical mass, measuring about $12\frac{1}{2}$ cm. in diameter, located at base of left posterior chest between the levels of the fifth rib and the eleventh interspace. It shows no evidence of invading the remaining parts of the chest and appears to be arising from the left side of the vertebral border of the chest cavity. Fluoroscopically it is fixed, does not move with respiration, does not pulsate, nor does it displace the heart shadow. The lung appears to glide about it with respiration.

Conclusions: Cyst of left chest attached to left side of spinal column.

Patient was re-examined July 14, 1924, eleven days after the first examination, and condition was unchanged. She was again examined on January 17, 1925, practically six months after the first examination, and there was no perceptible change in the size or shape of the mass.

Following this third X-ray examination the patient was referred to Dr. F. S. Morris,



Fig. 1. Left lateral, at six feet.

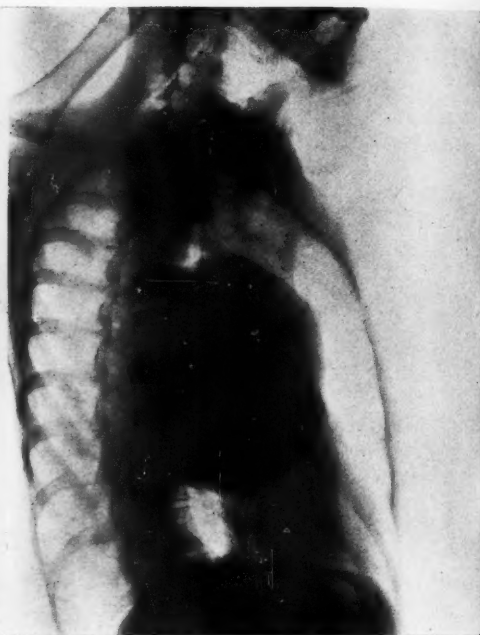


Fig. 2. Left oblique, at six feet.

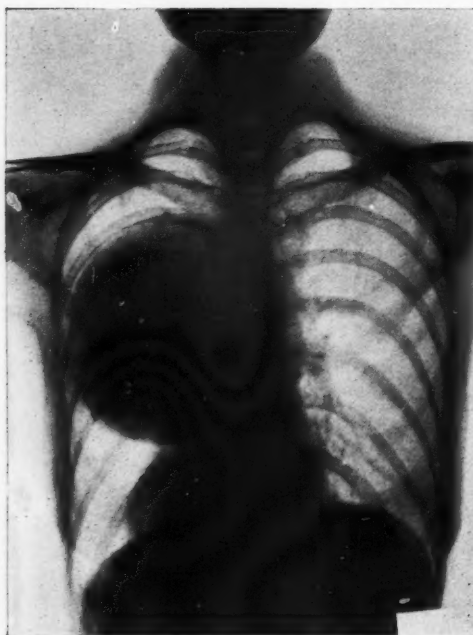


Fig. 3. A-P. posterior, at six feet.

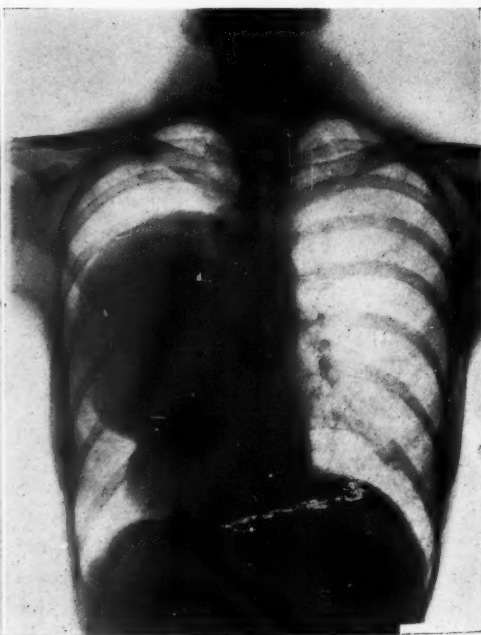


Fig. 4. A-P. anterior, at six feet.

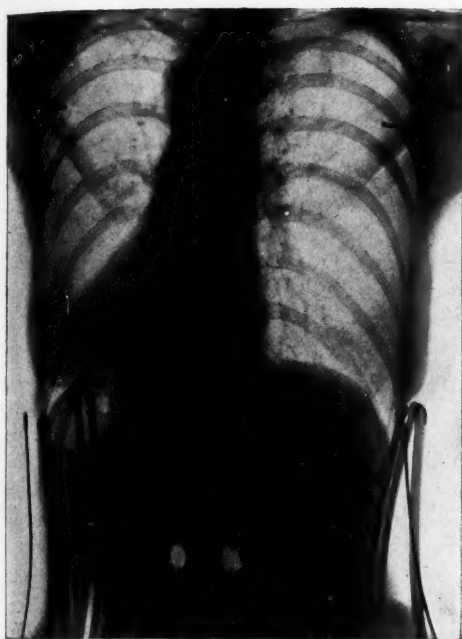


Fig. 5. A.-P. posterior, at six feet, showing condition six months after operation.

of the Homeopathic Hospital, Pittsburgh, Pa., for operation.

Pathological diagnosis made by Dr. J. G. Wurtz, Pathologist of the hospital: Subpleural fibrolipoma. This diagnosis was confirmed by members of the Clinical-Pathological Society of Pittsburgh, when the tumor, X-ray films, and microscopic sections were shown at a recent meeting.

Six months following the operation, radiograms of the chest showed resection of the sixth, seventh, eighth and ninth ribs at the posterior angle on the left side, with no evidence of the previously existing tumor, lungs and mediastinum being normal. Patient, however, showed no increase in weight and her general physical appearance was unchanged.

The writer wishes to express his appreciation to Dr. J. G. Hemington, of Uniontown, Pa., for the privilege of reporting this case, and also to Dr. E. H. Pond, Radiologist of the Pittsburgh Homeopathic Hospital, for supplying him with a copy of the pathological findings.

EDITORIAL

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UNUNITED FRACTURES

There are few conditions more trying on the surgeon and disheartening to the patient than ununited fractures. In severe crushing injuries when the fracture is compound, one is not particularly surprised nor acutely disturbed if the union is delayed or even fails. When, however, this delay or failure of union occurs in the course of simple fractures in apparently healthy young individuals who present X-ray evidence of good apposition and alignment of fragments, one is considerably agitated, to say the least.

Those fractures in which union is not complete after the lapse of time usually required by similar fractures for repair are generally spoken of as cases of delayed union. They show a variable amount of callus formation, and a noticeable lack of firmness is apparent when the extremity is manipulated or used. In most cases ultimate repair is followed by a good functioning member.

Fractures which show little or no tendency to repair are spoken of as cases of non-union. Callus formation is deficient or practically absent and a false point of motion is commonly developed (pseudoarthrosis).

Statistics show that ununited fractures occur most frequently in the tibia, humerus, ulna and radius. The femur is the seat of many cases of non-union which are found in the middle third of the shaft or, in elderly persons, in the neck of the femur.

The causes of delayed union or non-union may be perfectly evident in some

instances, while in others a thorough, searching investigation may fail to clearly establish the underlying fault.

In some cases failure to unite may be attributed to a single factor, but more often two or more are responsible. One may divide the causes of ununited fracture into those due to local conditions and those due to general or systemic conditions. Under local causes we may include those within the bone itself which exert an inhibiting influence and those arising outside of the bone. In the former group may be mentioned tumor growth, tuberculosis and gumma formation; in the latter, such accidents as interposition of muscle or fascia and such mechanical defects as failure of proper immobilization and malposition of the fragments. The general or systemic conditions, while they are seldom the sole cause, are not infrequently contributing factors of considerable importance.

One has many surprises in dealing with the repair of fractures, and the paradoxes of Nature are often strikingly disclosed.

The author has recently had occasion to study the healing of fractures occurring in the extremities of children who showed the residual paralysis of earlier attacks of acute anterior poliomyelitis. These patients presented interesting X-ray pictures of the affected bones which showed marked atrophy and loss of structural detail. It is quite astonishing how quickly repair takes place in these fractures, with resultant firm union.

It is also a rather common observation that operative collapse of bone cysts, which have expanded the bone cortex to a thin shell, will be followed in a reasonable time by sufficient callus formation and repair to insure a functionally useful member.

Even in those spontaneous or pathological fractures occurring in long bones at the seat of metastatic carcinoma, one is agreeably surprised to see early callus formation

and sometimes repair to the extent of weight-bearing.

The causes of failure of union in bones have been the subject of much discussion, and considerable experimental work has been done in investigating the phenomena of bone growth and repair.

Recently attention has been directed to the relationship between bone repair and the calcium and phosphorus concentration in the blood stream. Much of this work was probably initiated by the investigation of McCollum¹ into the blood chemistry in rickets.

Howland and Kramer² showed by their studies that the blood of children with rickets had either a subnormal amount of calcium or phosphorus, or both. Further, healing did not take place until the calcium and phosphorus content was brought to normal.

Tisdall and Harris³ found in a study of adults who had normal healing fractures that the blood of these patients showed about 10 mg. of calcium and about 3.8 mg. of phosphorus in each 100 c.c. of blood serum. This relation of blood calcium to blood phosphorus has been expressed as an index by multiplying the calcium by the phosphorus in milligrams in 100 c.c. of serum.

Peterson⁴ conducted a series of clinical investigations which showed that when this index is in the neighborhood of 35, union of fractures usually occurs, but when this number is below 30 either delayed union or non-union results.

Collip⁵ has called attention to the parathyroid hormone in regulating the level of blood calcium. Recently Greenwald and

Gross⁶ have shown that the parathyroid hormone is the substance that keeps calcium phosphate in solution, or, at least, that it is necessary to the preparation of this hypothetical substance. Their experiments indicate that this hormone actually dissolves calcium phosphate, in addition to retarding its precipitation. This action of the parathyroid hormone is of interest in view of the recent suggestions relative to the giving of parathyroid substance to increase the calcium content of the blood, thereby facilitating the repair of fractures. It is important, however, to understand that this parathyroid hormone probably dissolves the calcium from existing stores of calcium in the body, especially in the bones; therefore, the increased concentration of blood calcium is not an evidence of increased assimilation, but represents a mobilization of calcium from existing deposits. Extreme caution is urged in the use of glandular therapy in the treatment of fractures.

The most important local factor in the repair of bone is a well nourished periosteum. It is a comparatively well known and easily understood fact that normal bone regeneration depends upon the presence of osteogenetic tissue rich in osteoblasts and that this tissue be served by a blood supply which must be maintained for a sufficient time to allow complete repair. If the blood supply be interrupted by too early movement, with consequent rupture of capillary vessels, there is likely to follow a certain amount of degeneration of callus, with replacement by connective tissue. The repetition of this disturbance of local blood supply may be the precursor of non-union or pseudoarthrosis.

Ollier,⁷ Lexer⁸ and Rohde⁹ have called attention to the importance of periosteum in the repair of bone. The compact bone and

¹ McCollum, E. V.: Pathologic effects of lack of antirachitic vitamins. *Jour. Am. Med. Assn.*, 81:894-899 (Sept. 15), 1923; *Jour. Biol. Chem.*, 47:507-527 (Aug.), 1921.

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³ Tisdall, F. F., and Harris, R. I.: Calcium and phosphorus metabolism in patients with fractures. *Jour. Am. Med. Assn.*, 79:884 (Sept. 9), 1922.

⁴ Peterson, H. A.: Clinical study of non-union of bone, with special reference to inorganic bone-forming elements of blood serum. *Jour. of Bone and Joint Surg.*, 6:22, 1924.

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⁷ Ollier, L.: *Traité expérimental et clinique de la régénération des os*. Parts I, II, 1867.

⁸ Lexer, E.: Quoted by Taylor, R. T.: Non-union of bone. *Surg., Gynec. and Obst.*, 40:862 (June), 1925.

⁹ Rohde, C.: How does bone form? *Surg., Gynec. and Obst.*, 41:740 (Dec.), 1925.

the medulla, with its endosteal limitation, are quite secondary in this process.

Henderson¹⁰ has called attention to the importance of severe direct injury in the production of ununited fractures. This severe injury may be associated with either a simple or compound fracture. Experimental work has served to explain in large part the important rôle played by these severe local injuries.

Lexer has shown that blood and lymph exudate offer poor conditions for bone-building. The organization of blood extravasations leads to scar formation, which offers an enormous obstacle to bone-growth. Again, we are familiar with the degeneration of periosteum when its blood supply is injured by crushing or freeing from the nourishing influence of the surrounding connective tissue.

The removal of the periosteum either by rough handling, metal plating, exposure or infection is a factor of tremendous importance in delaying the union of bone.

The importance of the periosteum in the healing of bone has been utilized in various ways by many surgeons. Froelich¹¹ and Delagénière¹² were the first to utilize osteoperiosteal grafts in the treatment of non-union. The massive bone graft has been especially recommended by Henderson and the free graft by Albee.¹³ The two latter are preferred where fixation is desirable.

Cotton¹⁴ and Marchand¹⁵ have recommended the use of insoluble calcium salts in transplantation and in the treatment of delayed union of fractures. It is supposed that these materials are used in bone formation through the activity of the osteoblasts.

With a comprehensive knowledge of the factors which influence the repair of bone, a good roentgenographic exhibition of the existing pathology, attention to the systemic

condition of the patient and a judicious application of surgical therapy, one should be able to successfully treat most cases of ununited fracture.

R. W. McNEALY, M.D.

IN MEMORIAM

It is the sad duty of the Necrology Committee to chronicle the passing of two more members of the Society, brief biographical sketches of whom follow.

ROY McLEOD MUNROE

Roy McLeod Munroe was born at Camden, Arkansas, October 18, 1889, the son of the Rev. Edmund Marshall Munroe, D.D., and Emma McRoe Munroe. He died February 23, 1926, of lobar pneumonia, at Temple, Texas.

Dr. Munroe was educated in the public schools of Milford, Texas, graduating from the Milford High School in 1906, the San Antonio Academy, San Antonio, Texas, in 1907, and attended Austin College, Sherman, Texas, from 1907 to 1909. He entered the Medical Department of the University of Texas at Galveston and was graduated with the degree of M.D. in 1913. He accepted an appointment as interne in St. Joseph's Infirmary, Houston, Texas, and served one year's internship there. He entered into general practice at Richmond, Texas, with Dr. J. Mark O'Farrell, and enjoyed a very profitable practice until 1918.

With the beginning of the World War he enlisted and served in the U. S. Army with the rank of First Lieutenant, being stationed at Camp Logan, Houston, Texas. On returning from his service in the Army he again resumed general practice at Milford, Texas,—1920 to 1925.

Being especially interested in radiology as a specialty he accepted an appointment as Assistant to Dr. Wilson at the Scott and White Clinic, Temple, Texas, during the latter part of 1925. Although young in this specialty, the untimely death of Dr. Munroe has robbed the science of radiology

¹⁰ Henderson, M. S.: Ununited fractures. *Jour. Am. Med. Assn.*, 86:2 (Jan. 9), 1926.

¹¹ Froelich: *Revue d'orthop.*, Jan., 1910.

¹² Delagénière, H.: Osteoperiosteal grafts. *Bull. d. l'Acad. d. Méd.*, 88:396, 1922; *Amer. Jour. Surg.*, 35:281 (Sept.), 1921.

¹³ Albee, F. H.: The free bone transplant. *Am. Jour. Surg.*, 28:21-26, 1914; *Jour. Am. Med. Assn.*, 81:1429 (Oct. 27), 1923.

¹⁴ Cotton, F. G.: Quoted by Rohde, C.: *Surg., Gynec. and Obst.*, 41:740 (Dec.), 1925.

¹⁵ Marchand, J. H.: Quoted by Rohde, C.: *Surg., Gynec. and Obst.*, 41:740 (Dec.), 1925.

of one whose untiring energies would have carried him to prominence in his chosen field.

CHARLES ALEXANDER PFENDER

Dr. Pfender was born at Round Top, Texas, January 18, 1878, and died in Boston, Massachusetts, February 17, 1926. He began his education in the public schools of Round Top and Gonzales, Texas. After completing high school he engaged in the practice of practical veterinary science in order to procure funds for a medical education. In 1901 he went to Washington, D. C., as assistant in the zoology laboratory of the Department of Agriculture, and while there was associated with Dr. Charles Wardell Stiles and Dr. Brayton H. Ransom. The same year he entered George Washington University Medical School, graduating with the degree of M.D. in 1905, after which time he was active in his chosen profession. In 1911 he began to devote himself exclusively to the field of roentgenology and electrotherapy. During the World War he was appointed to serve on Medical Advisory Board No. 3 as roentgen specialist.

Recognition of Dr. Pfender's ability was evidenced by his appointment to various hospital staffs, among which may be mentioned Sibley Memorial Hospital and the Tuberculosis Hospital, Georgetown University Hospital, and Gallinger Memorial Hospital. He was connected with Georgetown University Medical School for many years in various teaching capacities and had held the professorship of roentgenology and electrotherapy since 1919.

Dr. Pfender was a prolific writer, many of his original articles, chiefly on roentgenology, appearing in the medical journals. He was a member of the Medical Society of the District of Columbia, the American Roentgen Ray Society, the Helminthological Society, the Society of Parasitology, and Society of Mental and Nervous Diseases of the District of Columbia. He was also a

member of the University Club of Washington and the Calvary Baptist Church. Dr. Pfender became a member of the Radiological Society of North America in 1920 and took a very active interest in all its meetings.

BOOK REVIEW

INTESTINAL TUBERCULOSIS, ITS IMPORTANCE, DIAGNOSIS AND TREATMENT. By LAWRASON BROWN, M.D., Chairman of the Medical Board of the Trudeau Sanatorium, Saranac Lake, New York, and HOMER L. SAMPSON, Roentgenographer of the Trudeau Sanatorium. Lea & Febiger, Philadelphia. 1926. Pages 304. Price \$4.00.

This volume, the first of a series, represents the researches of a part of the staff of the Trudeau Sanatorium, along one of its particular lines of endeavor. The authors need no introduction to the medical profession and, as would be expected, the subject is presented in a manner in keeping with their ability and reputation.

The entire subject of intestinal tuberculosis is covered in a most comprehensive manner by twenty-eight well arranged chapters. Of particular interest are those devoted to the pathologic anatomy, clinical manifestations, roentgenologic diagnosis and treatment of the disease. The radiologist will find much of interest in the chapters devoted to roentgen-ray methods of diagnosis, the importance of which is justified by the statement that it is the only method which will diagnose intestinal tuberculosis in its incipency or exclude it at any stage.

Numerous photographs of pathologic specimens, charts and roentgenograms illustrate the text which is printed on an excellent grade of paper. A most comprehensive bibliography is also included.

JOHN D. CAMP, M.D.

ABSTRACTS OF CURRENT LITERATURE

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Treatment of inoperable cancer.—This extremely interesting report is based on the cases treated at the Radiumhemmet, the cancer hospital at Stockholm, founded by the Swedish Cancer Research Society and partially supported by the Government. The institution is in charge of Gosta Forssell and the author is his associate. Three hundred and seventy-five cases of inoperable cancer of the cervix were treated between 1916 and 1922. Of these, 90 per cent were relieved of hemorrhage, 60 per cent of vaginal discharge, 53 per cent of pain and 61 per cent became able to work again. The periods of relief were variable and are given specifically by numbers under each head. The final results show 17.9 per cent of three-year cures and 16.7 per cent of five-year cures. It should be emphasized that these cases were all inoperable and quite hopeless except from the radiological standpoint.

Between 1915 and 1922, 54 cases of inoperable cancer of the body of the uterus were treated. In some of these cases, the inoperable status was determined by the general condition of the patient rather than by the local condition of the growth. Of these, 59 per cent were free of symptoms after three years; 58 per cent of the earlier ones in the series after five years. This series is further divided by listing separately the cases in which the inoperable character was determined by other and general conditions. Of this latter class, 6 out of 8 cases treated prior to 1919 show five-year cures, that is to say, 75 per cent, while 87.5 per cent of the somewhat later series show three-year cures.

Fifteen cases of cancer of the ovary show no five-year cures, no four-year cures and only 8

per cent of three-year cures. These were entirely inoperable cases. On the other hand, 23 cases of the same period in which incomplete operation of some kind was performed, usually consisting of removal of all or most of the primary growth, show 21 per cent of five-year cures and 31 per cent of three-year cures.

There are smaller series of cases of cancer of the vagina (primary), cancer of the urethra and cancer of the vulva. In all of these the end-results are rather discouraging, particularly in cancer of the vulva. In the latter class the changes in technic of treatment are described, with a rather detailed account of the present method, which consists of electrocoagulation of the tumor with radium application to the cleansed surface immediately after. The technic employed in treatment of cervical lesions is likewise described in some detail. The reader is struck particularly by three things: First, the remarkable way in which the clinical material is controlled and the records kept up to date; second, the rather moderate doses of radium and X-rays, the main reliance being placed in all cases on the former agent, and third, the excellent results achieved in cancers of the uterus. The article, which is presumably reprinted from the *Journal of the British Medical Association*, since the paper was originally presented before a section of that Society, is very well worth reading in full.

CHARLES D. ENFIELD, M.D.

The Treatment of Inoperable Cancer of the Female Pelvic Organs. James Heymann. Am. Jour. Physical Therapy, Dec., 1925, p. 417.

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